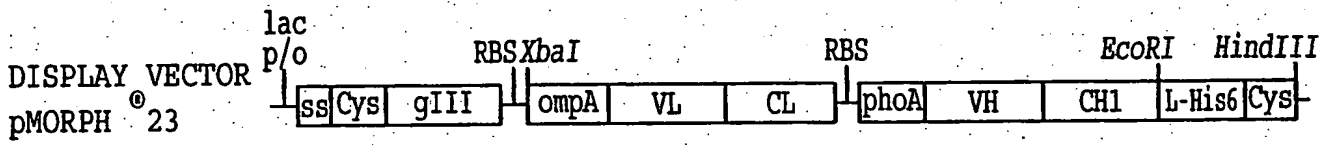

DISPLAY VECTOR
pMORPH ® 23
lac
p/o
RBS
XbaI
RBS
EcoRI
HindIII
ss
Cys
gIII
ompA
VL
CL
phoA
VH
CH1
L-His6
Cys

FIG. 1

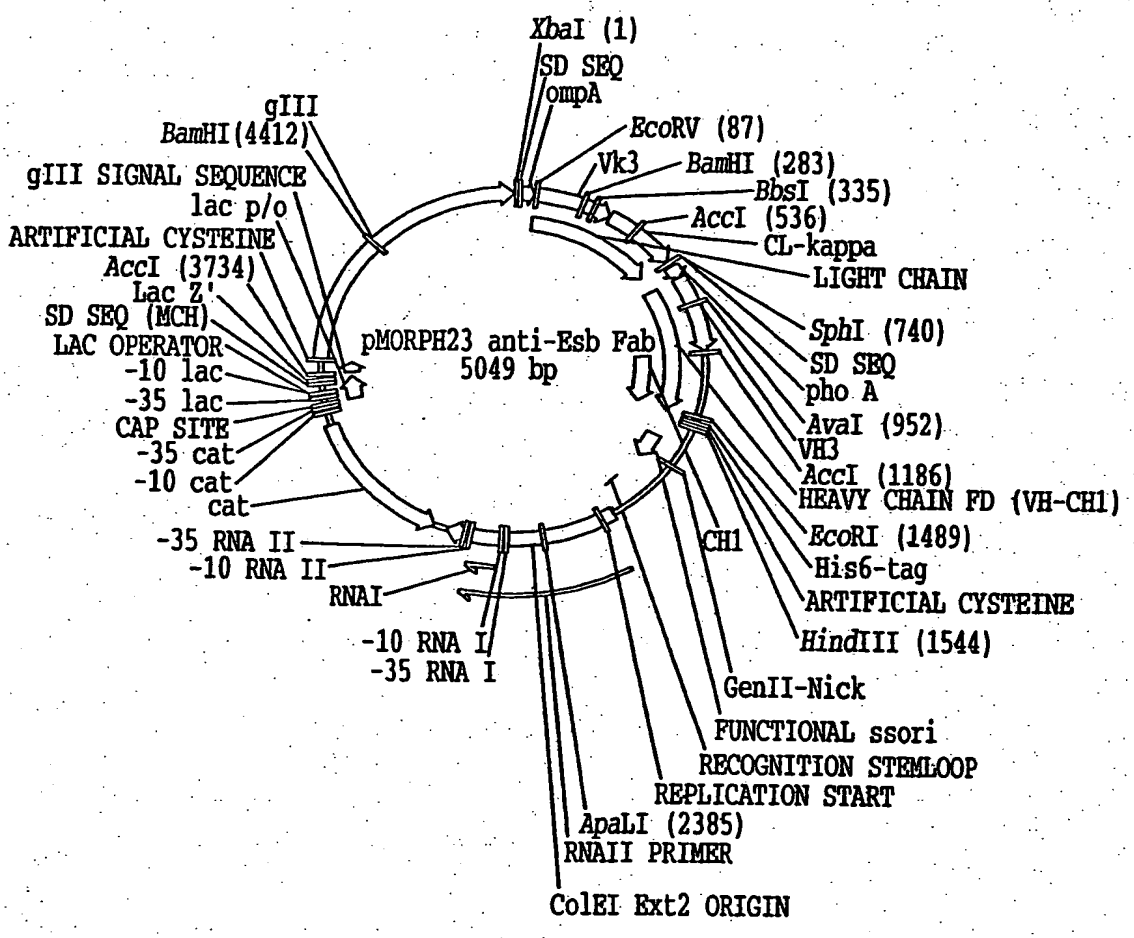
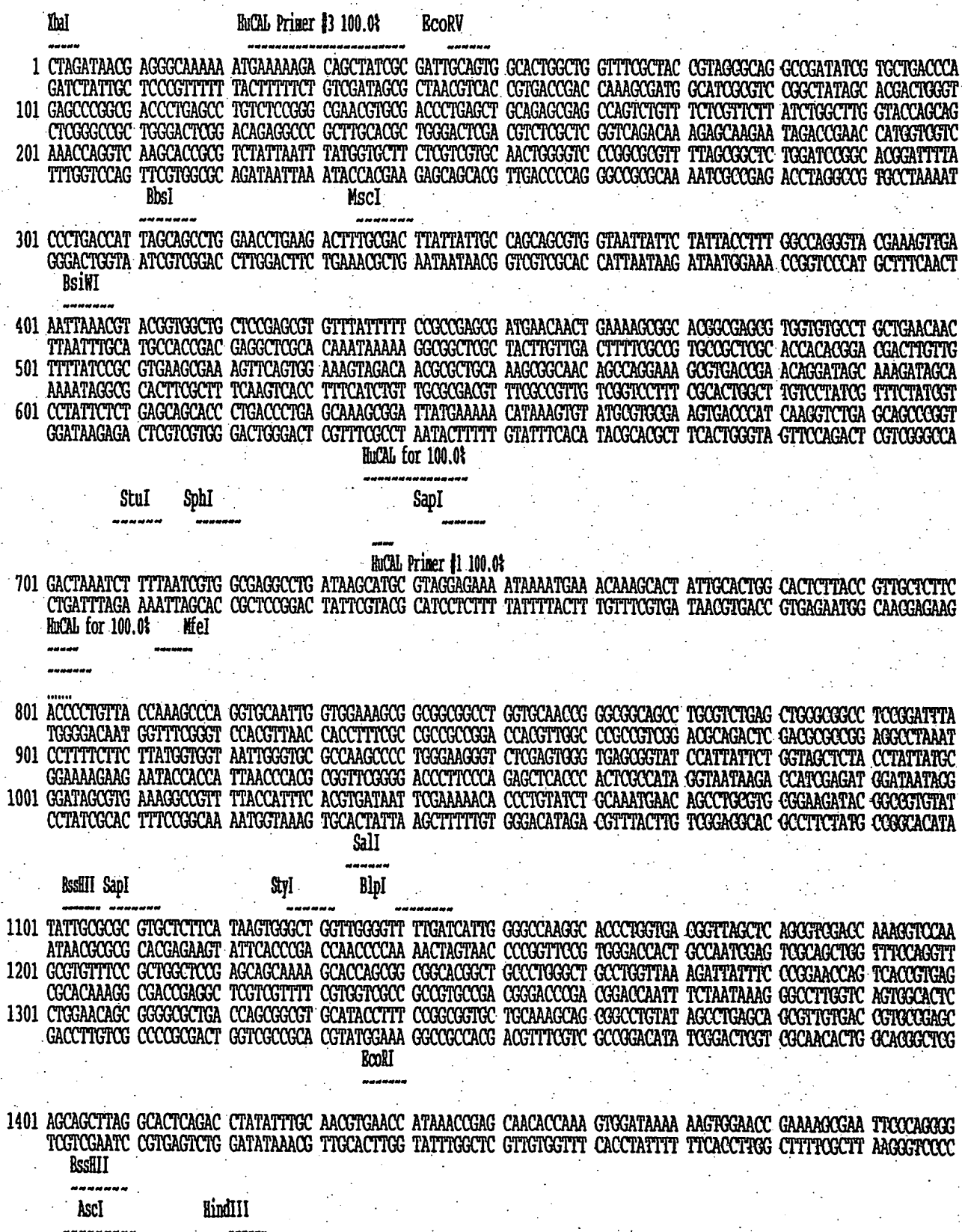

XbaI (1)
SD SEQ
ompA
EcoRV (87)
Vk3
BamHI (283)
BbsI (335)
AccI (536)
CL-kappa
LIGHT CHAIN
SphI (740)
SD SEQ
pho A
AvaI (952)
VH3
AccI (1186)
HEAVY CHAIN FD (VH-CH1)
EcoRI (1489)
His6-tag
ARTIFICIAL CYSTEINE
HindIII (1544)
GenII-Nick
FUNCTIONAL ssori
RECOGNITION STEMLOOP
REPLICATION START
ApaLI (2385)
RNAII PRIMER
ColEI Ext2 ORIGIN
-10 RNA I
-35 RNA I
RNAI
-10 RNA II
-35 RNA II
cat
-10 cat
-35 cat
CAP SITE
-35 lac
-10 lac
LAC OPERATOR
SD SEQ (MCH)
Lac Z'
AccI (3734)
ARTIFICIAL CYSTEINE
lac p/o
gIII SIGNAL SEQUENCE
BamHI (4412)
gIII
pMORPH23 anti-Esb Fab
5049 bp
CH1

FIG. 2A


XhaI
HuCAL Primer #3 100.0%
EcoRV
BbsI
MscI
BsiWI
StuI
SphI
SapI
HuCAL for 100.0%
HuCAL Primer #1 100.0%
HuCAL for 100.0%
MfeI
SalI
BssHII
SapI
StyI
BlpI
EcoRI
BssHII
AscI
HindIII

HuCAL rev 100.0%

```
1501 GGAGCGGAGG CGCGCCGCAC CATCATCACC ATCACTGCTG ATAAGCTTGA CCTGTGAAGT GAAAAATGGC GCAGATTGTG CGACATTTTT TTTGTCTGCC
     CCTCGCCTCC GCGCGGCGTG GTAGTAGTGG TAGTGACGAC TATTCGAACT GGACACTTCA CTTTTTACCG CGTCTAACAC GCTGTAAAAA AAACAGACGG
1601 GTTTAATGAA ATTGTAAACG TTAATATTTT GTTAAAATTC GCGTTAAATT TTTGTTAAAT CAGCTCATTT TTTAACCAAT AGGCCGAAAT CGGCAAAATC
     CAAATTACTT TAACATTTGC AATTATAAAA CAATTTTAAG CGCAATTTAA AAACAATTTA GTCGAGTAAA AAATTGGTTA TCCGGCTTTA GCCGTTTTAG
1701 CCTTATAAAT CAAAAGAATA GACCGAGATA GGGTTGAGTG TTGTTCCAGT TTGGAACAAG AGTCCACTAT TAAAGAACGT GGACTCCAAC GTCAAAGGGC
     GGAATATTTA GTTTTCTTAT CTGGCTCTAT CCCAACTCAC AACAAGGTCA AACCTTGTTC TCAGGTGATA ATTTCTTGCA CCTGAGGTTG CAGTTTCCCG
1801 GAAAAACCGT CTATCAGGGC GATGGCCCAC TACGAGAACC ATCACCCTAA TCAAGTTTTT TGGGGTCGAG GTGCCGTAAA GCACTAAATC GGAACCCTAA
     CTTTTTGGCA GATAGTCCCG CTACCGGGTG ATGCTCTTGG TAGTGGGATT AGTTCAAAAA ACCCCAGCTC CACGGCATTT CGTGATTTAG CCTTGGGATT
1901 AGGGAGCCCC CGATTTAGAG CTTGACGGGG AAAGCCGGCG AACGTGGCGA GAAAGGAAGG GAAGAAAGCG AAAGGAGCGG GCGCTAGGGC GCTGGCAAGT
     TCCCTCGGGG GCTAAATCTC GAACTGCCCC TTTCGGCCGC TTGCACCGCT CTTTCCTTCC CTTCTTTCGC TTTCCTGCCC CGCGATCCCG CGACCGTTCA
                                NheI
2001 GTAGCGGTCA CGCTGCGCGT AACCACCACA CCCGCCGCGC TTAATGCGCC GCTACAGGGC GCGTGCTAGC CATGTGAGCA AAAGGCCAGC AAAAGGCCAG
     CATCGCCAGT GCGACGCGCA TTGGTGGTGT GGGCGGCGCG AATTACGCGG CGATGTCCCG CGCACGATCG GTACACTCGT TTTCCGGTCG TTTTCCGGTC
2101 GAACCGTAAA AAGGCCGCGT TGCTGGCGTT TTTCCATAGG CTCCGCCCCC CTGACGAGCA TCACAAAAAT CGACGCTCAA GTCAGAGGTG GCGAAACCCG
     CTTGGCATTT TTCCGGCGCA ACGACCGCAA AAAGGTATCC GAGGCGGGGG GACTGCTCGT AGTGTTTTTA GCTGCGAGTT CAGTCTCCAC CGCTTTGGGC
2201 ACAGGACTAT AAAGATACCA GGCGTTTCCC CCTGGAAGCT CCCTCGTGCG CTCTCCTGTT CCGACCCTGC CGCTTACCGG ATACCTGTCC GCCTTTCTCC
     TGTCCTGATA TTTCTATGGT CCGCAAAGGG GGACCTTCGA GGGAGCACGC GAGAGGACAA GGCTGGGACG GCGAATGGCC TATGGACAGG CGGAAAGAGG
2301 CTTCGGGAAG CGTGGCGCTT TCTCATAGCT CACGCTGTAG GTATCTCAGT TCGGTGTAGG TCGTTCGCTC CAAGCTGGGC TGTGTGCACG AACCCCCCGT
     GAAGCCCTTC GCACCGCGAA AGAGTATCGA GTGCGACATC CATAGAGTCA AGCCACATCC AGCAAGCGAG GTTCGACCCG ACACACGTGC TTGGGGGGCA
2401 TCAGTCCGAC CGCTGCGCCT TATCCGGTAA CTATCGTCTT GAGTCCAACC CGGTAAGACA CGACTTATCG CCACTGGCAG CAGCCACTGG TAACAGGATT
     AGTCAGGCTG GCGACGCGGA ATAGGCCATT GATAGCAGAA CTCAGGTTGG GCCATTCTGT GCTGAATAGC GGTGACCGTC GTCGGTGACC ATTGTCCTAA
2501 AGCAGAGCGA GGTATGTAGG CGGTGCTACA GAGTTCTTGA AGTGGTGGCC TAACTACGGC TACACTAGAA GAACAGTATT TGGTATCTGC GCTCTGCTGT
     TCGTCTCGCT CCATACATCC GCCACGATGT CTCAAGAACT TCACCACCGG ATTGATGCCG ATGTGATCTT CTTGTCATAA ACCATAGACG CGAGACGACA
2601 AGCCAGTTAC CTTCGGAAAA AGAGTTGGTA GCTCTTGATC CGGCAAACAA ACCACCGCTG GTAGCGGTGG TTTTTTTGTT TGCAAGCAGC AGATTACGCG
     TCGGTCAATG GAAGCCTTTT TCTCAACCAT CGAGAACTAG GCCGTTTGTT TGGTGGCGAC CATCGCCACC AAAAAAACAA ACGTTCGTCG TCTAATGCGC
                                                BglII
2701 CAGAAAAAAA GGATCTCAAG AAGATCCTTT GATCTTTTCT ACGGGGTCTG ACGCTCAGTG GAACGAAAAC TCACGTTAAG GGATTTTGGT CAGATCTAGC
     GTCTTTTTTT CCTAGAGTTC TTCTAGGAAA CTAGAAAAGA TGCCCCAGAC TGCGAGTCAC CTTGCTTTTG AGTGCAATTC CCTAAAACCA GTCTAGATCG
2801 ACCAGGCGTT TAAGGGCACC AATAACTGCC TTAAAAAAAT TACGCCCCGC CCTGCCACTC ATCGCAGTAC TGTTGTAATT CATTAAGCAT TCTGCCGACA
     TGGTCCGCAA ATTCCCGTGG TTATTGACGG AATTTTTTTA ATGCGGGGCG GGACGGTGAG TAGCGTCATG ACAACATTAA GTAATTGGTA AGACGGCTGT
2901 TGGAAGCCAT CACAAACGGC ATGATGAACC TGAATCGCCA GCGGCATCAG CACCTTGTCG CCTTGCGTAT AATATTTGCC CATAGTGAAA ACGGGGGCGA
     ACCTTCGGTA GTGTTTGCCG TACTACTTGG ACTTAGCGGT CGCCGTAGTC GTGGAACAGC GGAACGCATA TTATAAACGG GTATCACTTT TGCCCCGCT
3001 AGAAGTTGTC CATATTGGCT ACGTTTAAAT CAAAACTGGT GAAACTCACC CAGGGATTGG CTGAGACGAA AAACATATTC TCAATAAACC CTTTAGGGAA
     TCTTCAACAG GTATAACCGA TGCAAATTTA GTTTTGACCA CTTTGAGTGG GTCCCTAACC GACTCTGCTT TTTGTATAAG AGTTATTTGG GAAATCCCTT
3101 ATAGGCCAGG TTTTCACCGT AACACGCCAC ATCTTGCGAA TATATGTGTA GAAACTGCCG GAAATCGTCG TGGTATTCAC TCCAGAGCGA TGAAAACGTT
     TATCCGGTCC AAAAGTGGCA TTGTGCGGTG TAGAACGCTT ATATACACAT CTTTGACGGC CTTTAGCAGC ACCATAAGTG AGGTCTGGCT ACTTTTGCAA
3201 TCAGTTTGCT CATGGAAAAC GGTGTAACAA GGGTGAACAC TATCCCATAT CACCAGCTCA CCGTCTTTCA TTGCCATACG GAACTCCGGG TGAGCATTCA
     AGTCAAACGA GTACCTTTTG CCACATTGTT CCCACTTGTG ATAGGGTATA GTGGTCGAGT GGCAGAAAGT AACGGTATGC CTTGAGGCCC ACTCGTAAGT
3301 TCAGGCGGGC AAGAATGTGA ATAAAGGCCG GATAAAACTT GTGCTTATTT TTCTTTACGG TCTTTAAAAA GGCCGTAATA TCCAGCTGAA CGGTCTGGTT
     AGTCCGCCCG TTCTTACACT TATTTCCGGC CTATTTTGAA CACGAATAAA AAGAAATGCC AGAAATTTTT CCGGCATTAT AGGTCGACTT GCCAGACCAA
3401 ATAGGTACAT TGAGCAACTG ACTGAAATGC CTCAAAATGT TCTTTACGAT GCCATTGGGA TATATCAACG GTGGTATATC CAGTGATTTT TTTCTCCATT
     TATCCATGTA ACTCGTTGAC TGACTTTACG GAGTTTTACA AGAAATGCTA CGGTAACCCT ATATAGTTGC CACCATATAG GTCACTAAAA AAAGAGGTAA
                                                AatII
3501 TTAGCTTCCT TAGCTCCTGA AAATCTCGAT AACTCAAAAA ATACGCCCGG TAGTGATCTT ATTTCATTAT GGTGAAAGTT GGAACCTCAC CCGACGTCTA
     AATCGAAGGA ATCGAGGACT TTTAGAGCTA TTGAGTTTTT TATGCGGGCC ATCACTAGAA TAAAGTAATA CCACTTTCAA CCTTGGAGTG GGCTGCAGAT
                                                M13 rev 100.0%
```

FIG. 2B-2

```
3601 ATGTGAGTTA GCTCACTCAT TAGGCACCCC AGGCTTTACA CTTTATGCTT CCGGCTCGTA TGTTGTGTGG AATTGTGAGC GGATAACAAT TTCACACAGG
     TACACTCAAT CGAGTGAGTA ATCCGTGGGG TCCGAAATGT GAAATACGAA GGCCGAGCAT ACAACACACC TTAACACTCG CCTATTGTTA AAGTGTGTCC
     M13 rev 100.0%
     ~~~~~~~~~~~~~~
3701 AAACAGCTAT GACCATGATT ACGAATTTCT AGTATACGAG GGCAAAAAAT GAAAAAACTG CTGTTCGCGA TTCCGCTGGT GGTGCCGTTC TATAGCCATA
     TTTGTCGATA CTGGTACTAA TGCTTAAAGA TCATATGCTC CCGTTTTTTA CTTTTTTGAC GACAAGCGCT AAGGCGACCA CCACGGCAAG ATATCGGTAT
3801 GCGACTACTG CGACATCGAG TTTGCAGAAA CAGTTGAAAG TTGTTTAGCA AAACCCCATA CAGAAAATTC ATTTACTAAC GTCTGGAAAG ACGACAAAAC
     CGCTGATGAC GCTGTAGCTC AAACGTCTTT GTCAACTTTC AACAAATCGT TTTGGGGTAT GTCTTTTAAG TAAATGATTG CAGACCTTTC TGCTGTTTTG
3901 TTTAGATCGT TACGCTAACT ATGAGGGCTG TCTGTGGAAT GCTACAGGCG TTGTAGTTTG TACTGGTGAC GAAACTCAGT GTTACGGTAC ATGGGTTCCT
     AAATCTAGCA ATGCGATTGA TACTCCCGAC AGACACCTTA CGATGTCCGC AACATCAAAC ATGACCACTG CTTTGAGTCA CAATGCCATG TACCCAAGGA
4001 ATTGGGCTTG CTATCCCTGA AAATGAGGGT GGTGGCTCTG AGGGTGGCGG TTCTGAGGGT GGCGGCTCTG AGGGTGGCGG TACTAAACCT CCTGAGTACG
     TAACCCGAAC GATAGGGACT TTTACTCCCA CCACCGAGAC TCCCACCGCC AAGACTCCCA CCGCCGAGAC TCCCACCGCC ATGATTTGGA GGACTCATGC
4101 GTGATACACC TATTCCGGGC TATACTTATA TCAACCCTCT CGACGGCACT TATCCGCCTG GTACTGAGCA AAACCCCGCT AATCCTAATC CTTCTCTTGA
     CACTATGTGG ATAAGGCCCG ATATGAATAT AGTTGGGAGA GCTGCCGTGA ATAGGCGGAC CATGACTCGT TTTGGGGCGA TTAGGATTAG GAAGAGAACT
4201 GGAGTCTCAG CCTCTTAATA CTTTCATGTT TCAGAATAAT AGGTTCCGAA ATAGGCAGGG GGCATTAACT GTTTATACGG GCACTGTTAC TCAAGGCACT
     CCTCAGAGTC GGAGAATTAT GAAAGTACAA AGTCTTATTA TCCAAGGCTT TATCCGTCCC CCGTAATTGA CAAATATGCC CGTGACAATG AGTTCCGTGA
4301 GACCCCGTTA AAACTTATTA CCAGTACACT CCTGTATCAT CAAAAGCCAT GTATGACGCT TACTGGAACG GTAAATTCAG AGACTGGGCT TTCCATTCTG
     CTGGGGCAAT TTTGAATAAT GGTCATGTGA GGACATAGTA GTTTTCGGTA CATACTGCGA ATGACCTTGC CATTTAAGTC TCTGACGCGA AAGGTAAGAC
4401 GCTTTAATGA GGATCCATTC GTTTGTGAAT ATCAAGGCCA ATCGTCTGAC CTGCCTCAAC CTCCTGTCAA TGCTGGCGGC GGCTCTGGTG GTGGTTCTGG
     CGAAATTACT CCTAGGTAAG CAAACACTTA TAGTTCCGGT TAGCAGACTG GACGGAGTTG GAGGACAGTT ACGACCGCCG CCGAGACCAC CACCAAGACC
4501 TGGCGGCTCT GAGGGTGGCG GCTCTGAGGG TGGCGGTTCT GAGGGTGGCG GCTCTGAGGG TGGCGGTTCC GGTGGCGGCT CCGGTTCCGG TGATTTTGAT
     ACCGCCGAGA CTCCCACCGC CGAGACTCCC ACCGCCAAGA CTCCCACCGC CGAGACTCCC ACCGCCAAGG CCACCGCGGA GGCCAAGGCC ACTAAAACTA
4601 TATGAAAAAA TGGCAAACGC TAATAAGGGG GCTATGACCG AAAATGCCGA TGAAAACGCG CTACAGTCTG ACGCTAAAGG CAAACTTGAT TCTGTCGCTA
     ATACTTTTTT ACCGTTTGCG ATTATTCCCC CGATACTGGC TTTTACGGCT ACTTTTGCGC GATGTCAGAC TGCGATTTCC GTTTGAACTA AGACAGCGAT
4701 CTGATTACGG TGCTGCTATC GATGGTTTCA TTGGTGACGT TTCCGGCCTT GCTAATGGTA ATGGTGCTAC TGGTGATTTT GCTGGCTCTA ATTCCCAAAT
     GACTAATGCC ACGACGATAG CTACCAAAGT AACCACTGCA AAGGCGGAA CGATTACCAT TACCACGATG ACCACTAAAA CGACCGAGAT TAAGGGTTTA
4801 GGCTCAAGTC GGTGACGGTG ATAATTCACC TTTAATGAAT AATTTCCGTC AATATTTACC TTCTTTGCCT CAGTCGGTTG AATGTCGCCC TTATGTCTTT
     CCGAGTTCAG CCACTGCCAC TATTAAGTGG AAATTACTTA TTAAAGGCAG TTATAAATGG AAGAAACGGA GTCAGCCAAC TTACAGCGGG AATACAGAAA
4901 GGCGCTGGTA AACCATATGA ATTTTCTATT GATTGTGACA AAATAAACTT ATTCCGTGGT GTCTTTGCGT TTCTTTTATA TGTTGCCACC TTTATGTATG
     CCGCGACCAT TTGGTATACT TAAAAGATAA CTAACACTGT TTTATTTGAA TAAGGCACCA CAGAAACGCA AAGAAAATAT ACAACGGTGG AAATACATAC
                       XbaI
                       ~
                   AflII
                   ~~~~~~~
5001 TATTTTCGAC GTTTGCTAAC ATACTGCGTA ATAAGGAGTC TTAAGTAAT
     ATAAAAGCTG CAAACGATTG TATGACGCAT TATTCCTCAG AATTCATTA
```

FIG. 2B-3

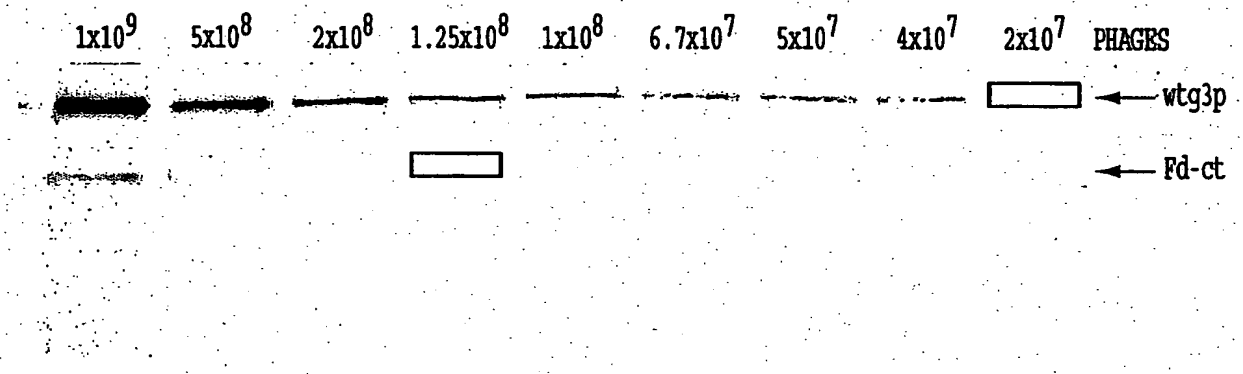

1x10^9
5x10^8
2x10^8
1.25x10^8
1x10^8
6.7x10^7
5x10^7
4x10^7
2x10^7
PHAGES
wtg3p
Fd-ct

FIG. 3

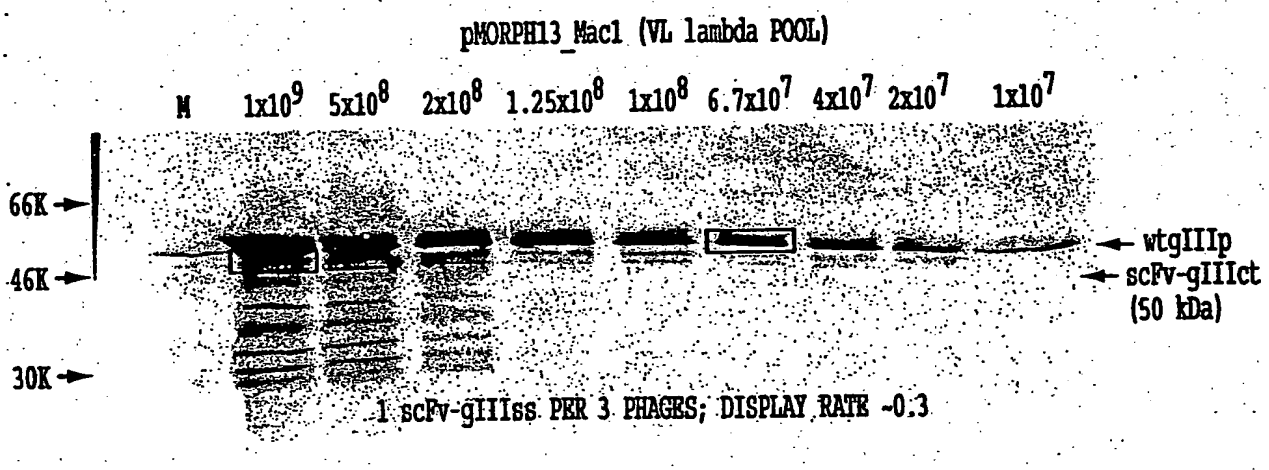

pMORPH13_Mac1 (VL lambda POOL)
M
1x10^9
5x10^8
2x10^8
1.25x10^8
1x10^8
6.7x10^7
4x10^7
2x10^7
1x10^7
66K
46K
30K
wtgIIIp
scFv-gIIIct
(50 kDa)
1 scFv-gIIIss PER 3 PHAGES; DISPLAY RATE ~0.3

FIG. 4A

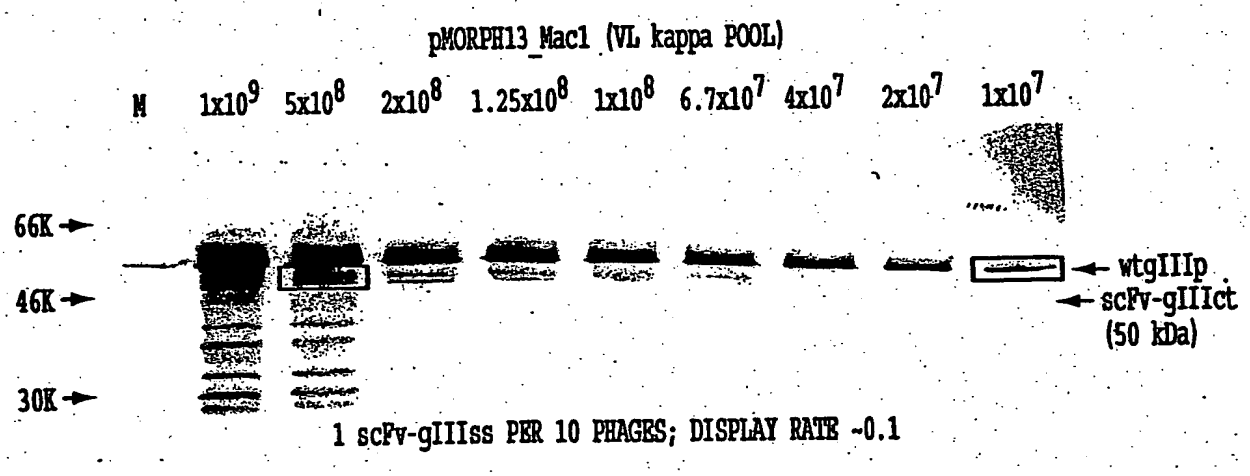

pMORPH13_Mac1 (VL kappa POOL)
M
1x10^9
5x10^8
2x10^8
1.25x10^8
1x10^8
6.7x10^7
4x10^7
2x10^7
1x10^7
66K
46K
30K
wtgIIIp
scFv-gIIIct
(50 kDa)
1 scFv-gIIIss PER 10 PHAGES; DISPLAY RATE ~0.1

FIG. 4B

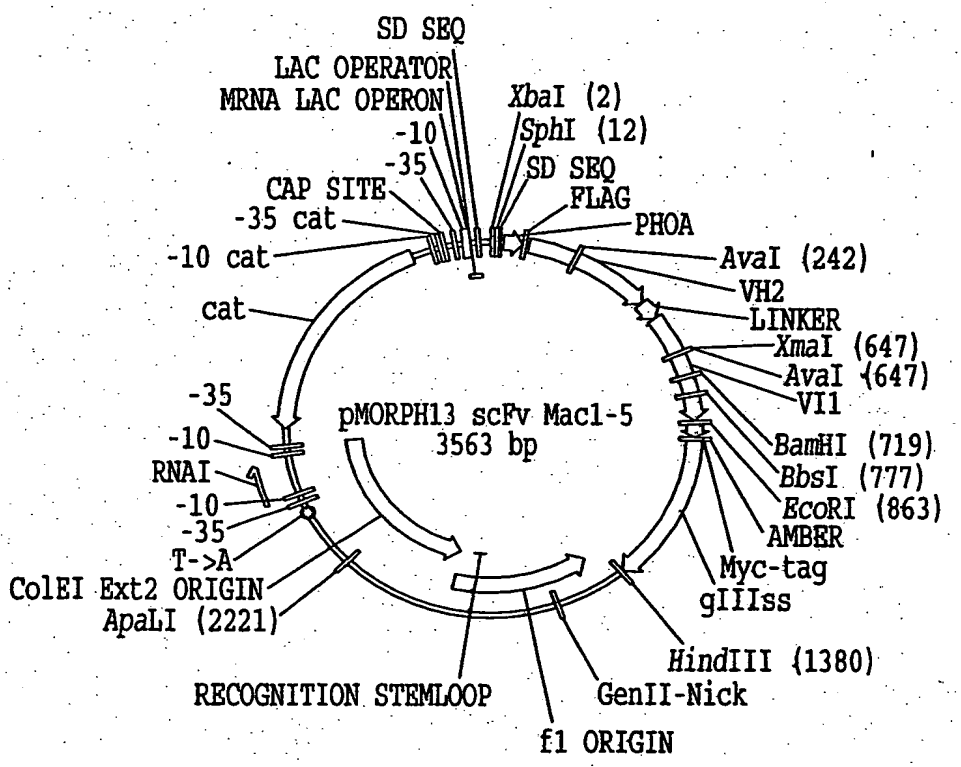

SD SEQ
LAC OPERATOR
MRNA LAC OPERON
-10
-35
CAP SITE
-35 cat
-10 cat
cat
-35
-10
RNAI
-10
-35
T->A
ColEI Ext2 ORIGIN
ApaLI (2221)
RECOGNITION STEMLOOP
f1 ORIGIN
GenII-Nick
HindIII (1380)
gIIIss
Myc-tag
AMBER
EcoRI (863)
BbsI (777)
BamHI (719)
VI1
AvaI (647)
XmaI (647)
LINKER
VH2
AvaI (242)
PHOA
FLAG
SD SEQ
SphI (12)
XbaI (2)
pMORPH13 scFv Mac1-5
3563 bp

FIG. 4C

tctagagcatgcgtaggagaaaataaaatgaaacaaagcactattgcactggcactcttaccgttgctcttcacccctgttaccaaa
gccgactacaaagatgaagtgcaattgaaagaaagcggcccggccctggtgaaaccgacccaaaccctgaccctgacctgtacct
tttccggatttagcctgtccacgtctggcgttggcgtgggctggattcgccagccgcctgggaaagccctcgagtggctggctctgat
tgattgggatgatgataagtattatagcaccagcctgaaaacgcgtctgaccattagcaaagatacttcgaaaaatcaggtggtgct
gactatgaccaacatggacccggtggatacggccacctattattgcgcgcgttttgatccttttttttgattcttttttttgattattggggc
caaggcaccctggtgacggttagctcagcgggtggcggttctggcggcggtgggagcggtggcggtggttctggcggtggtggtt
ccgatatcgtgctgacccagccgccttcagtgagtggcgcaccaggtcagcgtgtgaccatctcgtgtagcggcagcagcagcaac
attggcagcaactatgtgagctggtaccagcagttgcccgggacggcgccgaaactgctgatttatgataacaaccagcgtccctc
aggcgtgccggatcgttttagcggatccaaaagcggcaccagcgcgagccttgcgattacgggcctgcaaagcgaagacgaagc
ggattattattgccagagctatgaccagaatgctcttgttgaggtgtttggcggcggcacgaagttaaccgttcttggccaggaattc
gagcagaagctgatctctgaggaggatctgaactagggtggtggctctggttccggtgattttgattatgaaaagatggcaaacgc
taataaggggggctatgaccgaaaatgccgatgaaaacgcgctacagtctgacgctaaaggcaaacttgattctgtcgctactgatt
acggtgctgctatcgatggtttcattggtgacgtttccggccttgctaatggtaatggtgctactggtgattttgctggctctaattccc
aaatggctcaagtcggtgacggtgataattcacctttaatgaataatttccgtcaatatttaccttccctccctcaatcggttgaatgtc
gccctttttgtctttggcgctggtaaaccatatgaattttctattgattgtgacaaaataaacttattccgtggtgtctttgcgtttctttttat
atgttgccacctttatgtatgtattttctacgtttgctaacatactgcgtaataaggagtcttgataagcttgacctgtgaagtgaaaaa
tggcgcagattgtgcgacatttttttttgtctgccgtttaatgaaattgtaaacgttaatattttgttaaaattcgcgttaaatttttgttaa
atcagctcatttttttaaccaataggccgaaatcggcaaaatcccttataaatcaaaagaatagaccgagatagggttgagtgttgttc
cagtttggaacaagagtccactattaaagaacgtggactccaacgtcaaagggcgaaaaaccgtctatcagggcgatggcccact
acgagaaccatcaccctaatcaagttttttggggtcgaggtgccgtaaagcactaaatcggaaccctaaagggagcccccgattta
gagcttgacggggaaagccggcgaacgtggcgagaaaggaagggaagaaagcgaaaggagcgggcgctagggcgctggca
agtgtagcggtcacgctgcgcgtaaccaccacacccgccgcgcttaatgcgccgctacagggcgcgtgctagccatgtgagcaaa
aggccagcaaaaggccaggaaccgtaaaaggccgcgttgctggcgtttttccataggctccgcccccctgacgagcatcacaaa
aatcgacgctcaagtcagaggtggcgaaacccgacaggactataaagataccaggcgtttccccctggaagctccctcgtgcgctc
tcctgttccgaccctgccgcttaccggatacctgtccgcctttctcccttcgggaagcgtggcgctttctcatagctcacgctgtaggta
tctcagttcggtgtaggtcgttcgctccaagctgggctgtgtgcacgaacccccgttcagtccgaccgctgcgccttatccggtaact
atcgtcttgagtccaacccggtaagacacgacttatcgccactggcagcagccactggtaacaggattagcagagcgaggtatgta
ggcggtgctacagagttcttgaagtggtggcctaactacggctacactagaagaacagtatttggtatctgcgctctgctgtagcca
gttaccttcggaaaaagagttggtagctcttgatccggcaaacaaaccaccgctggtagcggtggtttttttgtttgcaagcagcag
attacgcgcagaaaaaaaggatctcaagaagatcctttgatcttttctacggggtctgacgctcagtggaacgaaaactcacgttaa
gggattttggtcagatctagcaccaggcgtttaagggcaccaataactgccttaaaaaaattacgccccgccctgccactcatcgca
gtactgttgtaattcattaagcattctgccgacatggaagccatcacaaacggcatgatgaacctgaatcgccagcggcatcagcac
cttgtcgccttgcgtataatatttgcccatagtgaaaacgggggcgaagaagttgtccatattggctacgtttaaatcaaaactggtg
aaactcacccagggattggctgagacgaaaaacatattctcaataaacccctttagggaaataggccaggttttcaccgtaacacgc
cacatcttgcgaatatatgtgtagaaactgccggaaatcgtcgtggtattcactccagagcgatgaaaacgtttcagtttgctcatgg
aaaacggtgtaacaagggtgaacactatcccatatcaccagctcaccgtctttcattgccatacggaactccgggtgagcattcatc
aggcgggcaagaatgtgaataaaggccggataaaacttgtgcttatttttctttacggtctttaaaaaggccgtaatatccagctga
acggtctggttataggtacattgagcaactgactgaaatgcctcaaaatgttctttacgatgccattgggatatatcaacggtggtat
atccagtgatttttttctccattttagcttccttagctcctgaaaatctcgataactcaaaaaatacgcccggtagtgatcttatttcatta
tggtgaaagttggaacctcacccgacgtctaatgtgagttagctcactcattaggcaccccaggctttacactttatgcttccggctcg
tatgttgtgtggaattgtgagcggataacaatttcacacaggaaacagctatgaccatgattacgaatt

FIG. 4D

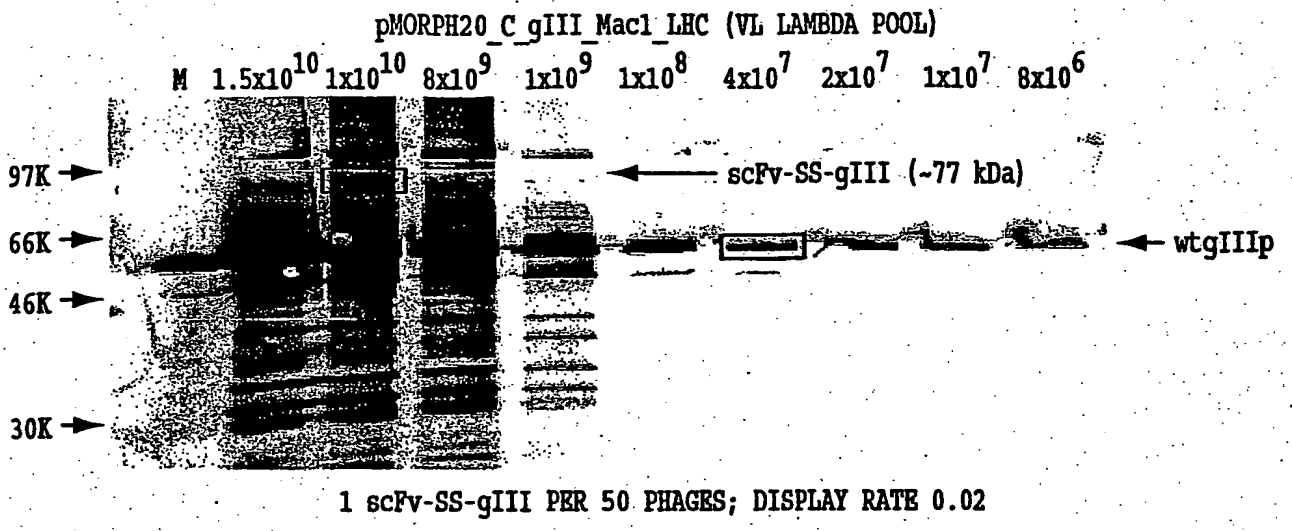

pMORPH20_C_gIII_MacI_LHC (VL LAMBDA POOL)
M 1.5x10^10 1x10^10 8x10^9 1x10^9 1x10^8 4x10^7 2x10^7 1x10^7 8x10^6
97K
66K
46K
30K
scFv-SS-gIII (~77 kDa)
wtgIIIp
1 scFv-SS-gIII PER 50 PHAGES; DISPLAY RATE 0.02

FIG. 5A

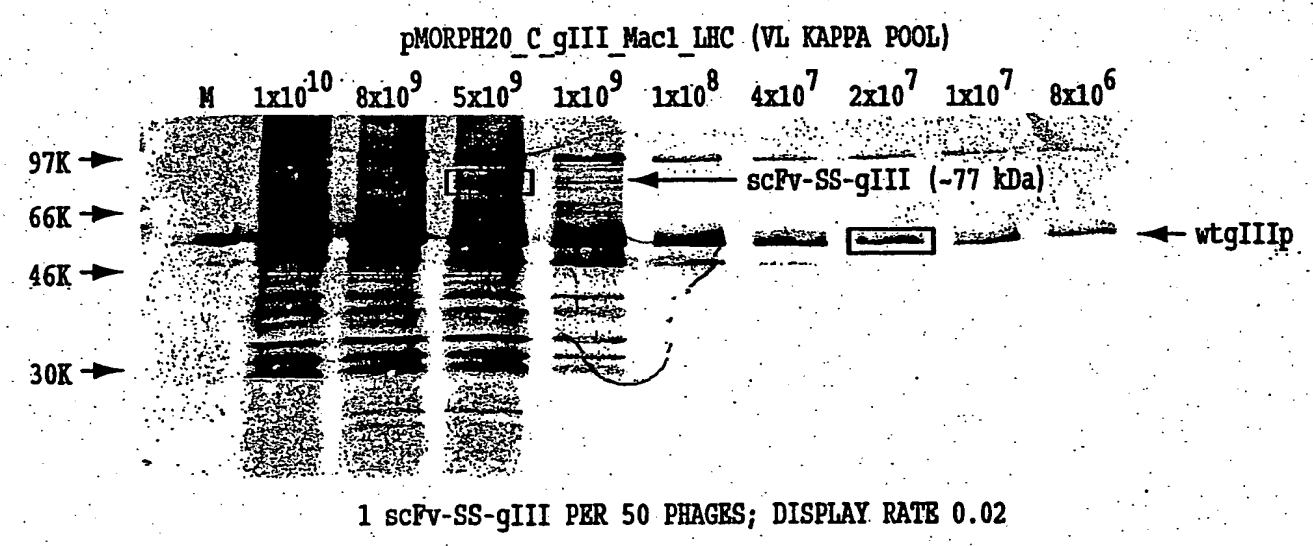

pMORPH20_C_gIII_MacI_LHC (VL KAPPA POOL)
M 1x10^10 8x10^9 5x10^9 1x10^9 1x10^8 4x10^7 2x10^7 1x10^7 8x10^6
97K
66K
46K
30K
scFv-SS-gIII (~77 kDa)
wtgIIIp
1 scFv-SS-gIII PER 50 PHAGES; DISPLAY RATE 0.02

FIG. 5B

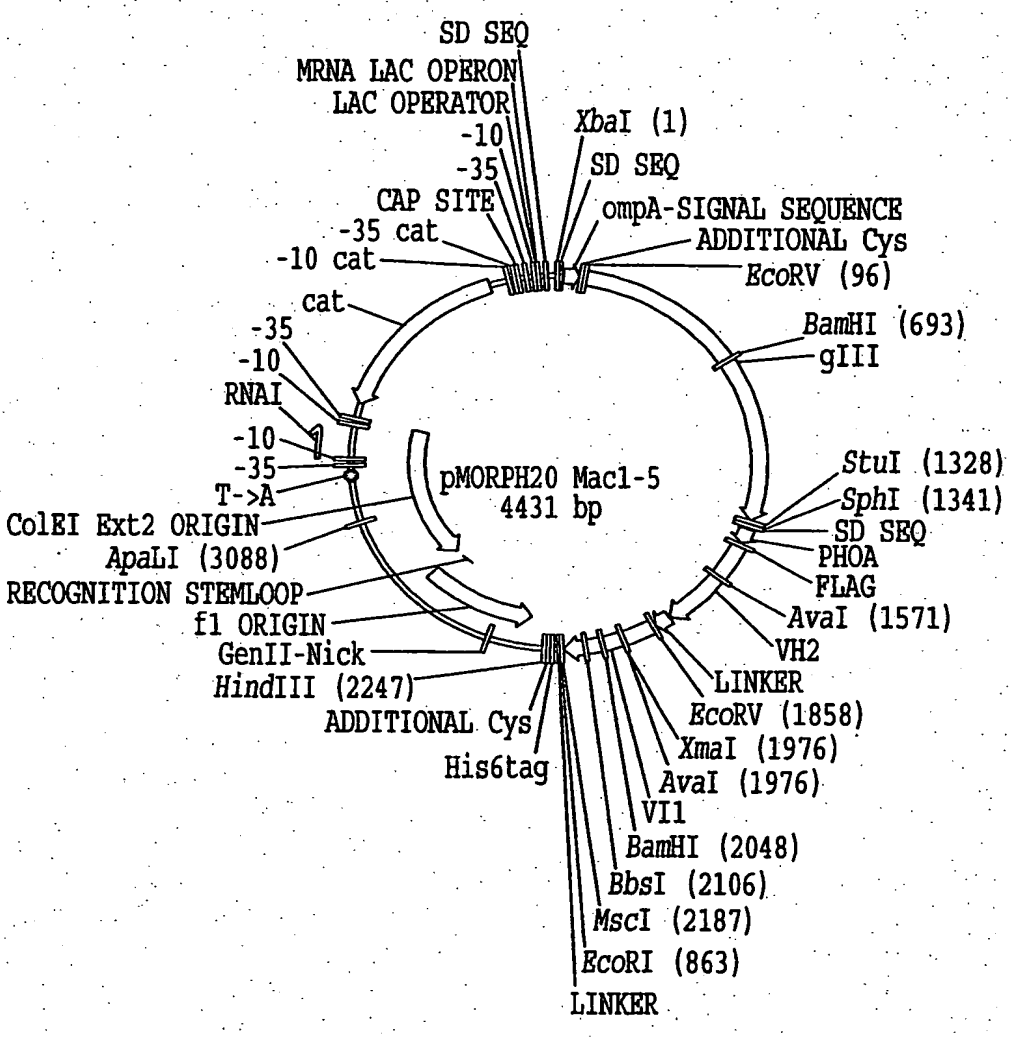

SD SEQ
MRNA LAC OPERON
LAC OPERATOR
-10
-35
CAP SITE
-35 cat
-10 cat
cat
-35
-10
RNAI
-10
-35
T->A
ColEI Ext2 ORIGIN
ApaLI (3088)
RECOGNITION STEMLOOP
f1 ORIGIN
GenII-Nick
HindIII (2247)
ADDITIONAL Cys
His6tag
LINKER
VI1
BamHI (2048)
BbsI (2106)
MscI (2187)
EcoRI (863)
XbaI (1)
SD SEQ
ompA-SIGNAL SEQUENCE
ADDITIONAL Cys
EcoRV (96)
BamHI (693)
gIII
StuI (1328)
SphI (1341)
SD SEQ
PHOA
FLAG
AvaI (1571)
VH2
LINKER
EcoRV (1858)
XmaI (1976)
AvaI (1976)
pMORPH20 Mac1-5
4431 bp

FIG. 5C

ctagataacgagggcaaaaaatgaaaaagacagctatcgcgattgcagtggcactggctggtttcgctaccgtagcg
caggccgactactgcgatatcgagtttgcagaaacagttgaaagttgtttagcaaaaccccatacagaaaattcattta
ctaacgtctggaaagacgacaaaacttttagatcgttacgctaactatgagggctgtctgtggaatgctacaggcgttgt
agtttgtactggtgacgaaactcagtgttacggtacatgggttcctattgggcttgctatccctgaaaatgagggtggtg
gctctgagggtggcggttctgagggtggcggctctgagggtggcggtactaaacctcctgagtacggtgatacaccta
ttccgggctatacttatatcaaccctctcgacggcacttatccgcctggtactgagcaaaaccccgctaatcctaatccttc
tcttgaggagtctcagcctcttaatactttcatgtttcagaataataggttccgaaataggcaggggcattaactgttta
tacgggcactgttactcaaggcactgaccccgttaaaacttattaccagtacactcctgtatcatcaaaagccatgtatg
acgcttactggaacggtaaattcagagactgcgctttccattctggctttaatgaggatccattcgtttgtgaatatcaag
gccaatcgtctgacctgcctcaacctcctgtcaatgctggcggcggctctggtggtggttctggtggcggctctgagggt
ggcggctctgagggtggcggttctgagggtggcggctctgagggtggcggttccggtggcggctccggttccggtga
ttttgattatgaaaaaatggcaaacgctaataaggggggctatgaccgaaaatgccgatgaaaacgcgctacagtctga
cgctaaaggcaaacttgattctgtcgctactgattacggtgctgctatcgatggtttcattggtgacgtttccggccttgct
aatggtaatggtgctactggtgatttgctggctctaattcccaaatggctcaagtcggtgacggtgataattcaccttta
atgaataatttccgtcaatatttaccttctttgcctcagtcggttgaatgtcgcccttatgtctttggcgctggtaaaccata
tgaattttctattgattgtgacaaaataaacttattccgtggtgtctttgcgtttcttttatatgttgccacctttatgtatgta
ttttcgacgtttgctaacatactgcgtaataaggagtcttaaggcctgataagcatgcgtaggagaaaataaaatgaaa
caaagcactattgcactggcactcttaccgttgctcttcacccctgttaccaaagccgactacaaagatgaagtgcaatt
gaaagaaagcggcccggccctggtgaaaccgacccaaaccctgaccctgacctgtacctttccggatttagcctgtcc
acgtctggcgttggcgtgggctggattcgccagccgcctgggaaagccctcgagtggctggctctgattgattgggat
gatgataagtattatagcaccagcctgaaaacgcgtctgaccattagcaaagatacttcgaaaaatcaggtggtgctg
actatgaccaacatggacccggtggatacggccacctattattgcgcgcgttttgatcctttttttgattctttttttgattat
tggggccaaggcaccctggtgacggttagctcagcgggtggcggttctggcggcggtgggagcggtggcggtggttc
tggcggtggtggttccgatatcgtgctgacccagccgccttcagtgagtggcgcaccaggtcagcgtgtgaccatctcg
tgtagcggcagcagcagcaacattggcagcaactatgtgagctggtaccagcagttgcccgggacggcgccgaaact
gctgatttatgataacaaccagcgtccctcaggcgtgccggatcgttttagcggatccaaaagcggcaccagcgcgag
ccttgcgattacgggcctgcaaagcgaagacgaagcggattattattgccagagctatgaccagaatgctcttgttgag
gtgtttggcggcggcacgaagttaaccgttcttggccaggaattcccaggggggagcggaggcgcgccgcaccatca
tcaccatcactgctgataagcttgacctgtgaagtgaaaaatggcgcagattgtgcgacatttttttgtctgccgtttaa
tgaaattgtaaacgttaatattttgttaaaattcgcgttaaatttttgttaaatcagctcatttttaaccaataggccgaaa
tcggcaaaatcccttataaatcaaaagaatagaccgagatagggttgagtgttgttccagtttggaacaagagtccact
attaaagaacgtggactccaacgtcaaagggcgaaaaaccgtctatcagggcgatggcccactacgagaaccatcac
cctaatcaagtttttggggtcgaggtgccgtaaagcactaaatcggaaccctaaagggagcccccgatttagagcttg
acggggaaagccggcgaacgtggcgagaaaggaagggaagaaagcgaaaggagcgggcgctagggcgctggca
agtgtagcggtcacgctgcgcgtaaccaccacacccgccgcgcttaatgcgccgctacagggcgcgtgctagccatgt
gagcaaaaggccagcaaaaggccaggaaccgtaaaaggccgcgttgctggcgttttccataggctccgcccccct
gacgagcatcacaaaaatcgacgctcaagtcagaggtggcgaaacccgacaggactataaagataccaggcgtttcc
ccctggaagctccctcgtgcgctctcctgttccgaccctgccgcttaccggatacctgtccgcctttctcccttcgggaagc
gtggcgctttctcatagctcacgctgtaggtatctcagttcggtgtaggtcgttcgctccaagctgggctgtgtgcacga
acccccccgttcagtccgaccgctgcgccttatccggtaactatcgtcttgagtccaacccggtaagacacgacttatcgc
cactggcagcagccactggtaacaggattagcagagcgaggtatgtaggcggtgctacagagttcttgaagtggtgg
cctaactacggctacactagaagaacagtatttggtatctgcgctctgctgtagccagttaccttcggaaaaagagttgg
tagctcttgatccggcaaacaaaccaccgctggtagcggtggttttttgtttgcaagcagcagattacgcgcagaaaa
aaaggatctcaagaagatcctttgatcttttctacggggtctgacgctcagtggaacgaaaactcacgttaagggatttt
ggtcagatctagcaccaggcgtttaagggcaccaataactgccttaaaaaaattacgccccgccctgccactcatcgca
gtactgttgtaattcattaagcattctgccgacatggaagccatcacaaacggcatgatgaacctgaatcgccagcggc
atcagcaccttgtcgccttgcgtataatatttgcccatagtgaaaacgggggcgaagaagttgtccatattggctacgtt
taaatcaaaactggtgaaactcacccagggattggctgagacgaaaaacatattctcaataaaccctttagggaaata
ggccaggttttcaccgtaacacgccacatcttgcgaatatatgtgtagaaactgccggaaatcgtcgtggtattcactcc
agagcgatgaaaacgtttcagtttgctcatggaaaacggtgtaacaagggtgaacactatcccatatcaccagctcacc
gtctttcattgccatacggaactccgggtgagcattcatcaggcgggcaagaatgtgaataaaggccggataaaactt
gtgcttatttttctttacggtctttaaaaaggccgtaatatccagctgaacggtctggttataggtacattgagcaactga
ctgaaatgcctcaaaatgttctttacgatgccattgggatatatcaacggtggtatatccagtgatttttttctccattttag
cttccttagctcctgaaaatctcgataactcaaaaaatacgcccggtagtgatcttatttcattatggtgaaagttggaac
ctcacccgacgtctaatgtgagttagctcactcattaggcaccccaggctttacactttatgcttccggctcgtatgttgtg
tggaattgtgagcggataacaatttcacacaggaaacagctatgaccatgattacgaattt

FIG. 5D

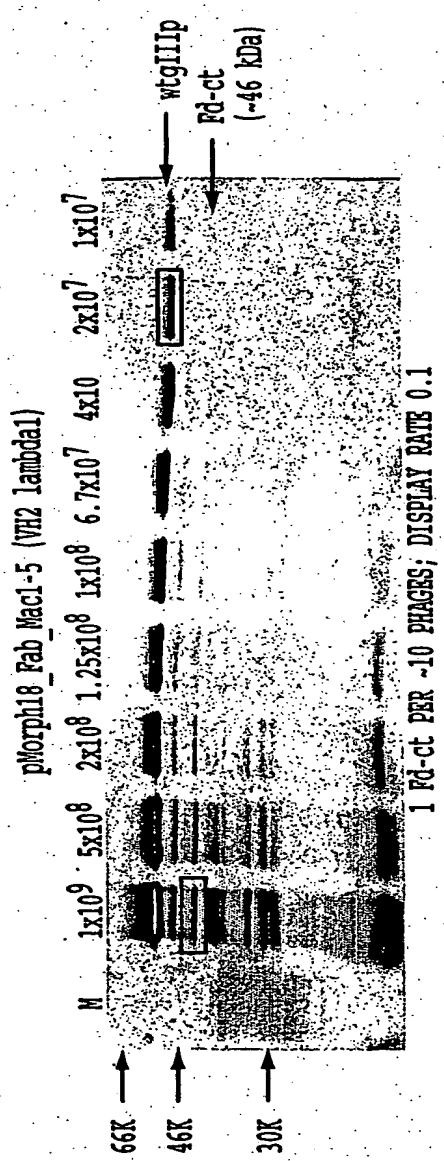

wtgIIIp
Fd-ct
(~46 kDa)
pMorph18_Fab_Mac1-5 (VH2 lambda1)
M
1x10^9
5x10^8
2x10^8
1.25x10^8
1x10^8
6.7x10^7
4x10
2x10^7
1x10^7
1 Fd-ct PER ~10 PHAGES; DISPLAY RATE 0.1
66K
46K
30K

FIG. 6A

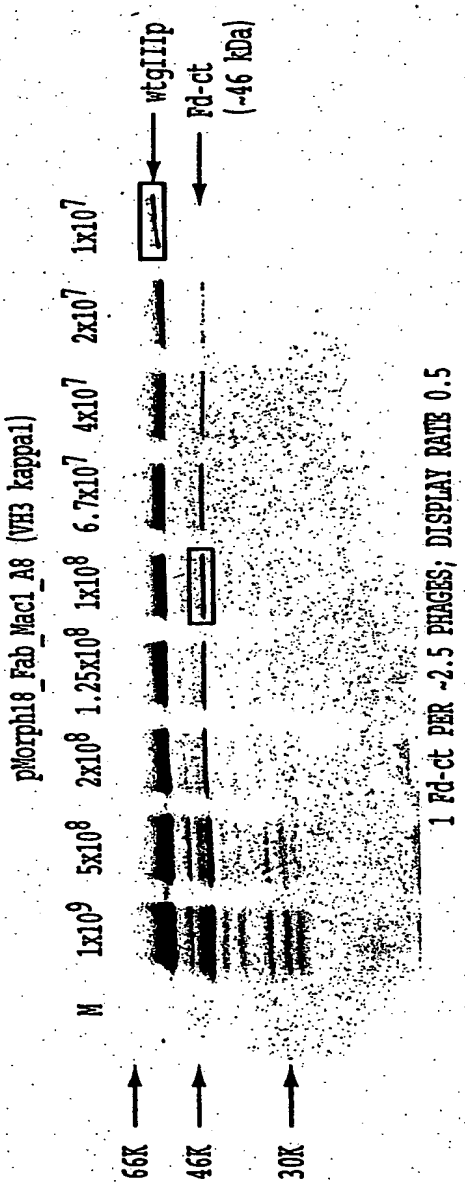

wtgIIIp
Fd-ct
(~46 kDa)
pMorph18_Fab_Mac1_A8 (VH3 kappa1)
M
1x10^9
5x10^8
2x10^8
1.25x10^8
1x10^8
6.7x10^7
4x10^7
2x10^7
1x10^7
1 Fd-ct PER ~2.5 PHAGES; DISPLAY RATE 0.5
66K
46K
30K

FIG. 6B

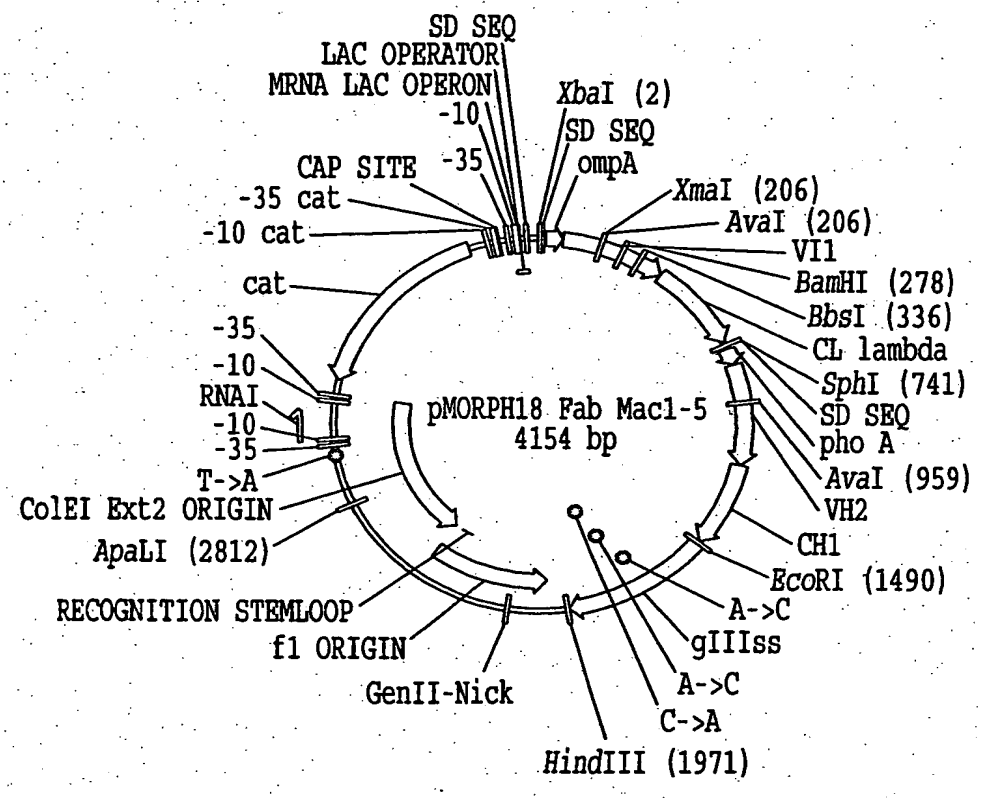

SD SEQ
LAC OPERATOR
MRNA LAC OPERON
-10
-35
CAP SITE
-35 cat
-10 cat
cat
-35
-10
RNAI
-10
-35
T->A
ColEI Ext2 ORIGIN
ApaLI (2812)
RECOGNITION STEMLOOP
f1 ORIGIN
GenII-Nick
HindIII (1971)
C->A
A->C
gIIIss
A->C
EcoRI (1490)
CH1
VH2
AvaI (959)
pho A
SD SEQ
SphI (741)
CL lambda
BbsI (336)
BamHI (278)
VI1
AvaI (206)
XmaI (206)
ompA
SD SEQ
XbaI (2)
pMORPH18 Fab Mac1-5
4154 bp

FIG. 6C

tctagataacgagggcaaaaaatgaaaaagacagctatcgcgattgcagtggcactggctggtttcgctaccgtagcg
caggccgatatcgtgctgacccagccgccttcagtgagtggcgcaccaggtcagcgtgtgaccatctcgtgtagcggc
agcagcagcaacattggcagcaactatgtgagctggtaccagcagttgcccgggacggcgccgaaactgctgatttat
gataacaaccagcgtccctcaggcgtgccggatcgttttagcggatccaaaagcggcaccagcgcgagccttgcgatt
acgggcctgcaaagcgaagacgaagcggattattattgccagagctatgaccagaatgctcttgttgaggtgtttggc
ggcggcacgaagttaaccgttcttggccagccgaaagccgcaccgagtgtgacgctgtttccgccgagcagcgaagaa
ttgcaggcgaacaaagcgaccctggtgtgcctgattagcgacttttatccgggagccgtgacagtggcctggaaggca
gatagcagccccgtcaaggcgggagtggagaccaccacaccctccaaacaaagcaacaacaagtacgcggccagcagc
tatctgagcctgacgcctgagcagtggaagtcccacagaagctacagctgccaggtcacgcatgaggggagcaccgtg
gaaaaaaccgttgcgccgactgaggcctgataagcatgcgtaggagaaaataaaatgaaacaaagcactattgcactg
gcactcttaccgttgctcttcacccctgttaccaaagcccaggtgcaattgaaagaaagcggcccggccctggtgaaa
ccgacccaaaccctgaccctgaccctgtacctttccggatttagcctgtccacgtctggcgttggcgtgggctggatt
cgccagccgcctgggaaagccctcgagtggctggctctgattgattgggatgatgataagtattatagcaccagcctg
aaaacgcgtctgaccattagcaaagatacttcgaaaaatcaggtggtgctgactatgaccaacatggacccggtggat
acggccacctattattgcgcgcgttttgatccttttttgattcttttttgattattggggccaaggcaccctggtg
acggttagctcagcgtcgaccaaaggtccaagcgtgtttccgctggctccgagcagcaaaagcaccagcggcggcacg
gctgccctgggctgcctggttaaagattatttcccggaaccagtcaccgtgagctggaacagcggggcgctgaccagc
ggcgtgcatacctttccggcggtgctgcaaagcagcggcctgtatagcctgagcagcgttgtgaccgtgccgagcagc
agcttaggcactcagacctatatttgcaacgtgaaccataaaccgagcaacaccaaagtggataaaaaagtggaaccg
aaaagcgaattcgggggagggagcgggagcggtgattttgattatgaaaagatggcaaacgctaataaggggctatg
accgaaaatgccgatgaaaacgcgctacagtctgacgctaaaggcaaacttgattctgtcgctactgattacggtgct
gctatcgatggtttcattggtgacgtttccggccttgctaatggtaatggtgctactggtgattttgctggctctaat
tcccaaatggctcaagtcggtgacggtgataattcacctttaatgaataatttccgtcaatatttaccttccctccct
caatcggttgaatgtcgccctttttgtctttggcgctggtaaaccatatgaattttctattgattgtgacaaaataaac
ttattccgtggtgtctttgcgtttctttttatatgttgccacctttatgtatgtattttctacgtttgctaacatactg
cgtaataaggagtcttgataagcttgacctgtgaagtgaaaaatggcgcagattgtgcgacatttttttttgtctgccg
tttaatgaaattgtaaacgttaatattttgttaaaattcgcgttaaatttttgttaaatcagctcatttttttaaccaa
taggccgaaatcggcaaaatcccttataaatcaaaagaatagaccgagatagggttgagtgttgttccagtttggaac
aagagtccactattaaagaacgtggactccaacgtcaaagggcgaaaaaccgtctatcagggcgatggcccactacga
gaaccatcaccctaatcaagtttttttggggtcgaggtgccgtaaagcactaaatcggaaccctaaagggagcccccga
tttagagcttgacggggaaagccggcgaacgtggcgagaaaggaagggaagaaagcgaaaggagcgggcgctagggcg
ctggcaagtgtagcggtcacgctgcgcgtaaccaccacacccgccgcgcttaatgcgccgctacagggcgcgtgctag
ccatgtgagcaaaaggccagcaaaaggccaggaaccgtaaaaggccgcgttgctggcgtttttccataggctccgcc
cccctgacgagcatcacaaaaatcgacgctcaagtcagaggtggcgaaacccgacaggactataaagataccaggcgt
ttccccctggaagctccctcgtgcgctctcctgttccgaccctgccgcttaccggatacctgtccgcctttctcccttt
cgggaagcgtggcgctttctcatagctcacgctgtaggtatctcagttcggtgtaggtcgttcgctccaagctgggct
gtgtgcacgaaccccccgttcagtccgaccgctgcgccttatccggtaactatcgtcttgagtccaacccggtaagac
acgacttatcgccactggcagcagccactggtaacaggattagcagagcgaggtatgtaggcggtgctacagagttct
tgaagtggtggcctaactacggctacactagaagaacagtatttggtatctgcgctctgctgtagccagttaccttcg
gaaaaagagttggtagctcttgatccggcaaacaaaccaccgctggtagcggtggttttttgtttgcaagcagcaga
ttacgcgcagaaaaaaaggatctcaagaagatcctttgatcttttctacggggtctgacgctcagtggaacgaaaact
cacgttaagggattttggtcagatctagcaccaggcgtttaagggcaccaataactgccttaaaaaaattacgccccg
ccctgccactcatcgcagtactgttgtaattcattaagcattctgccgacatggaagccatcacaaacggcatgatga
acctgaatcgccagcggcatcagcaccttgtcgccttgcgtataatatttgcccatagtgaaaacgggggcgaagaag
ttgtccatattggctacgtttaaatcaaaactggtgaaactcacccagggattggctgagacgaaaaacatattctca
ataaaccctttagggaaataggccaggttttcaccgtaacacgccacatcttgcgaatatatgtgtagaaactgccgg
aaatcgtcgtggtattcactccagagcgatgaaaacgtttcagtttgctcatggaaaacggtgtaacaagggtgaaca
ctatcccatatcaccagctcaccgtctttcattgccatacggaactccgggtgagcattcatcaggcgggcaagaatg
tgaataaaggccggataaaacttgtgcttatttttctttacggtctttaaaaaggccgtaatatccagctgaacggtc
tggttataggtacattgagcaactgactgaaatgcctcaaaatgttctttacgatgccattgggatatatcaacggtg
gtatatccagtgatttttttctccattttagcttccttagctcctgaaaatctcgataactcaaaaaatacgcccggt
agtgatcttatttcattatggtgaaagttggaacctcacccgacgtctaatgtgagttagctcactcattaggcaccc
caggctttacactttatgcttccggctcgtatgttgtgtggaattgtgagcggataacaatttcacacaggaaacagc
tatgaccatgattacgaatt

FIG. 6D

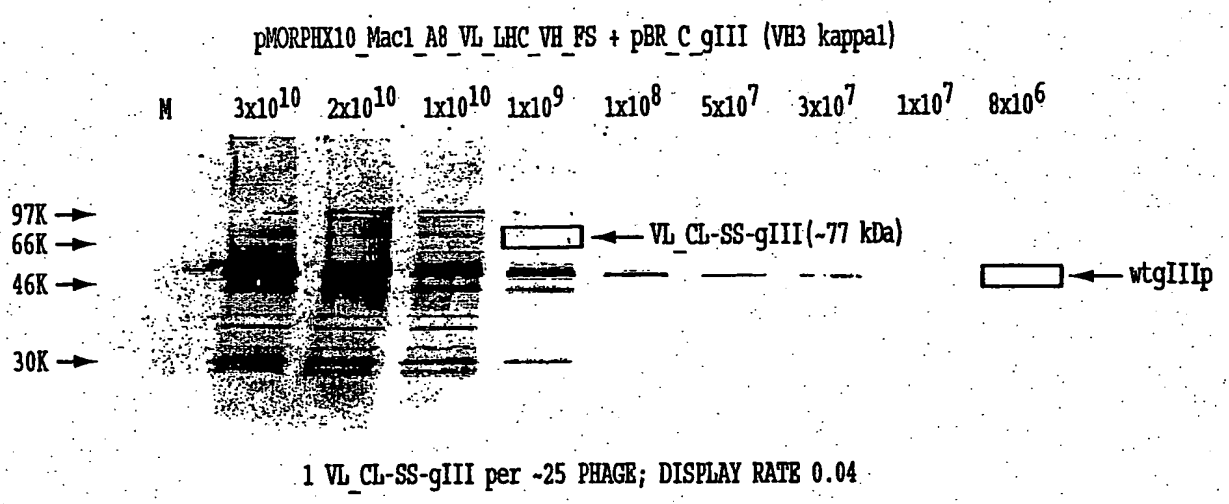

pMORPHX10_Mac1_A8_VL_LHC_VH_FS + pBR_C_gIII (VH3 kappa1)
M
3x10^10
2x10^10
1x10^10
1x10^9
1x10^8
5x10^7
3x10^7
1x10^7
8x10^6
97K
66K
46K
30K
VL_CL-SS-gIII(~77 kDa)
wtgIIIp
1 VL_CL-SS-gIII per ~25 PHAGE; DISPLAY RATE 0.04

FIG. 7A

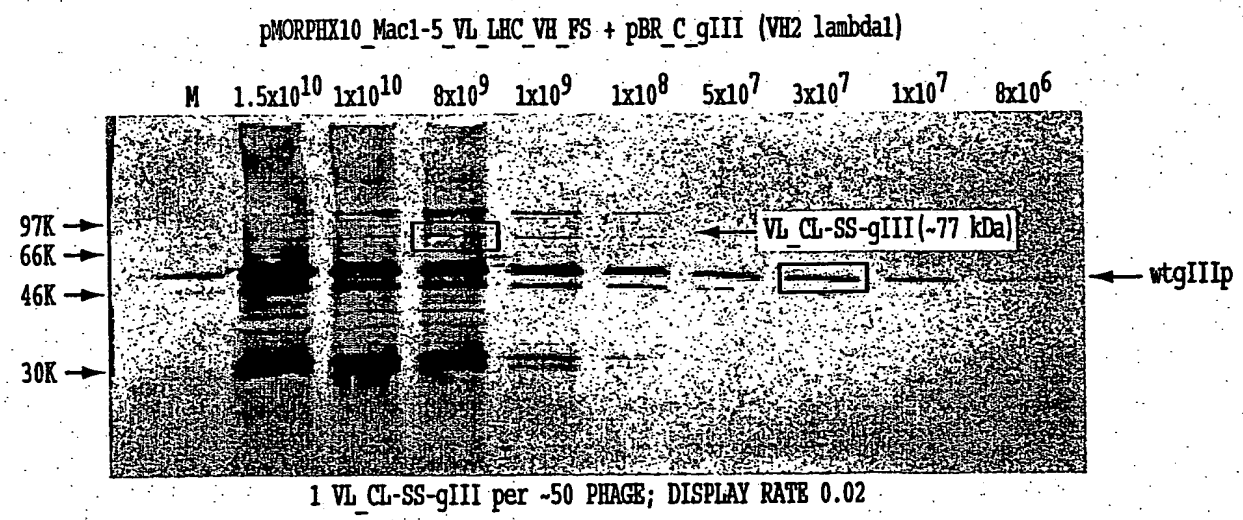

pMORPHX10_Mac1-5_VL_LHC_VH_FS + pBR_C_gIII (VH2 lambda1)
M
1.5x10^10
1x10^10
8x10^9
1x10^9
1x10^8
5x10^7
3x10^7
1x10^7
8x10^6
97K
66K
46K
30K
VL_CL-SS-gIII(~77 kDa)
wtgIIIp
1 VL_CL-SS-gIII per ~50 PHAGE; DISPLAY RATE 0.02

FIG. 7B

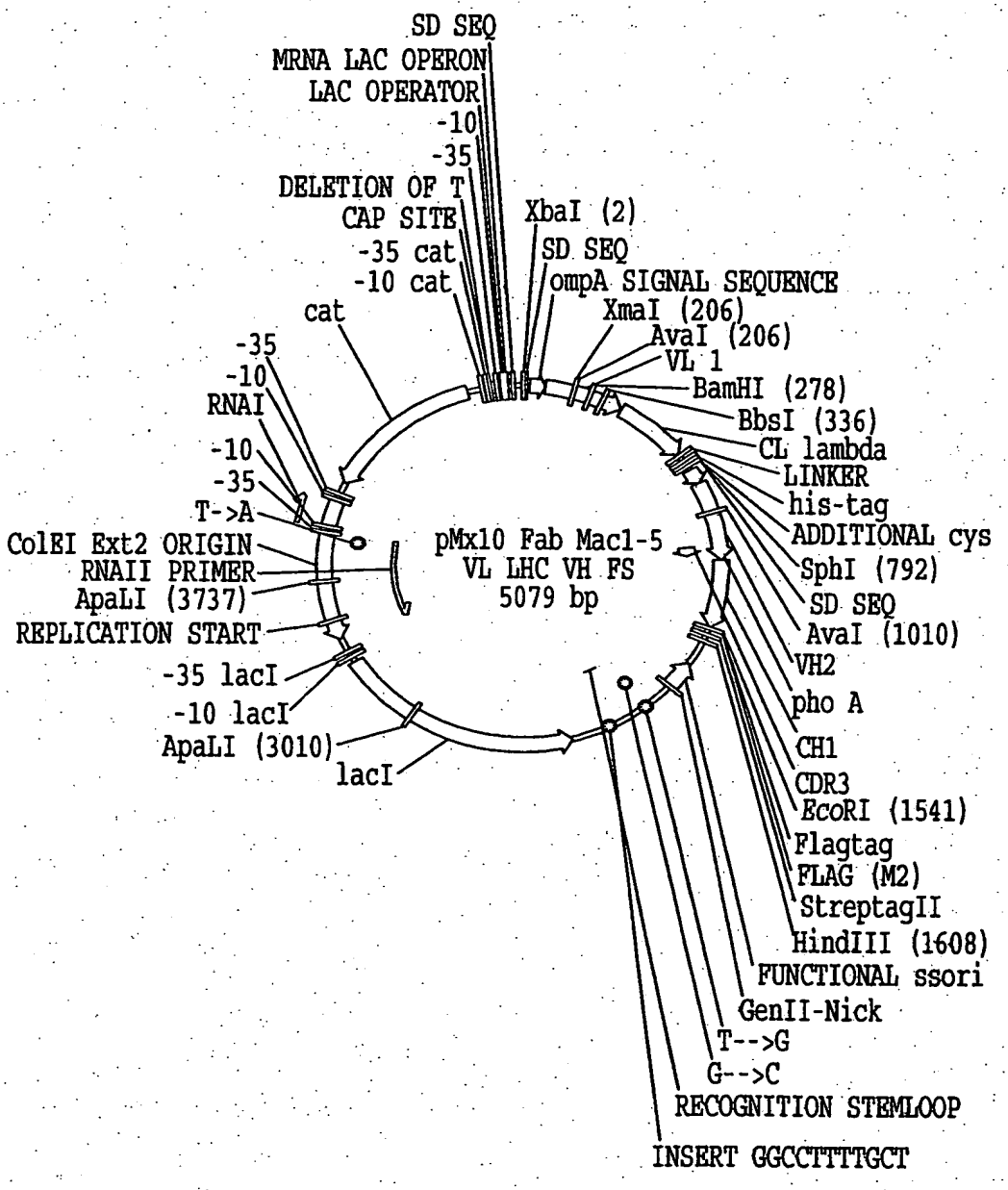

SD SEQ
MRNA LAC OPERON
LAC OPERATOR
-10
-35
DELETION OF T
CAP SITE
-35 cat
-10 cat
cat
XbaI (2)
SD SEQ
ompA SIGNAL SEQUENCE
XmaI (206)
AvaI (206)
VL 1
BamHI (278)
BbsI (336)
CL lambda
LINKER
his-tag
ADDITIONAL cys
SphI (792)
SD SEQ
AvaI (1010)
VH2
pho A
CH1
CDR3
EcoRI (1541)
Flagtag
FLAG (M2)
StreptagII
HindIII (1608)
FUNCTIONAL ssori
GenII-Nick
T-->G
G-->C
RECOGNITION STEMLOOP
INSERT GGCCTTTTGCT
-35
-10
RNAI
-10
-35
T->A
ColEI Ext2 ORIGIN
RNAII PRIMER
ApaLI (3737)
REPLICATION START
-35 lacI
-10 lacI
ApaLI (3010)
lacI
pMx10 Fab Mac1-5
VL LHC VH FS
5079 bp

FIG. 7C

cagcagttgcccgggacggcgccgaaactgctgatttatgataacaaccagcgtccctcaggcgtgccggatcgttttagcggatc
caaaagcggcaccagcgcgagccttgcgattacgggcctgcaaagcgaagacgaagcggattattattgccagagctatgacca
gaatgctcttgttgaggtgtttggcggcggcacgaagttaaccgttcttggccagccgaaagccgcaccgagtgtgacgctgtttcc
gccgagcagcgaagaattgcaggcgaacaaagcgaccctggtgtgcctgattagcgacttttatccgggagccgtgacagtggcc
tggaaggcagatagcagccccgtcaaggcgggagtggagaccaccacaccctccaaacaaagcaacaacaagtacgcggccag
cagctatctgagcctgacgcctgagcagtggaagtcccacagaagctacagctgccaggtcacgcatgaggggagcaccgtgga
aaaaaccgttgcgccgactgaggcctctccaggggggagcggaggcgcgccgcaccatcatcaccatcactgctgataatatgca
tgcgtaggagaaaataaaatgaaacaaagcactattgcactggcactcttaccgttgctcttcacccctgttaccaaagcccaggtg
caattgaaagaaagcggcccggccctggtgaaaccgacccaaaccctgaccctgaccctgtacctttccggatttagcctgtccacg
tctggcgttggcgtgggctggattcgccagccgcctgggaaagccctcgagtggctggctctgattgattgggatgatgataagtat
tatagcaccagcctgaaaacgcgtctgaccattagcaaagatacttcgaaaaatcaggtggtgctgactatgaccaacatggaccc
ggtggatacggccacctattattgcgcgcgttttgatccttttttgattcttttttgattattggggccaaggcaccctggtgacggtt
agctcagcgtcgaccaaaggtccaagcgtgtttccgctggctccgagcagcaaaagcaccagcggcggcacggctgccctgggct
gcctggttaaagattatttcccggaaccagtcaccgtgagctggaacagcggggcgctgaccagcggcgtgcataccttccggcg
gtgctgcaaagcagcggcctgtatagcctgagcagcgttgtgaccgtgccgagcagcagcttaggcactcagacctatatttgcaa
cgtgaaccataaaccgagcaacaccaaagtggataaaaaagtggaaccgaaaagcgaattcgactataaagatgacgatgacaa
aggcgcgccgtggagccacccgcagtttgaaaaatgataagcttgacctgtgaagtgaaaaatggcgcagattgtgcgacattttt
tttgtctgccgtttaattaaaggggggggggccggcctgggggggggtgtacatgaaattgtaaacgttaatattttgttaaaat
tcgcgttaaatttttgttaaatcagctcatttttaaccaataggccgaaatcggcaaaatcccttataaatcaaaagaatagaccga
gatagggttgagtgttgttccagtttggaacaagagtccactattaaagaacgtggactccaacgtcaaagggcgaaaaaccgtct
atcagggcgatggcccactacgagaaccatcaccctaatcaagtttttggggtcgaggtgccgtaaagcactaaatcggaaccct
aaagggagcccccgatttagagcttgacggggaaagccggcgaacgtggcgagaaaggaagggaagaaagcgaaaggagcg
ggcgctagggcgctggcaagtgtagcggtcacgctgcgcgtaaccaccacacccgccgcgcttaatgcgccgctacagggcgcgt
gctagactagtgtttaaaccggaccgggggggggcttaagtgggctgcaaaacaaaacggcctcctgtcaggaagccgcttttatc
gggtagcctcactgcccgctttccagtcgggaaacctgtcgtgccagctgcatcagtgaatcggccaacgcgcggggagaggcgg
tttgcgtattgggagccagggtggttttctttcaccagtgagacgggcaacagctgattgcccttcaccgcctggccctgagagag
ttgcagcaagcggtccacgctggtttgccccagcaggcgaaaatcctgtttgatggtggtcagcggcgggatataacatgagctgt
cctcggtatcgtcgtatcccactaccgagatgtccgcaccaacgcgcagcccggactcggtaatggcacgcattgcgcccagcgcc
atctgatcgttggcaaccagcatcgcagtgggaacgatgccctcattcagcatttgcatggtttgttgaaaaccggacatggcactcc
agtcgccttcccgttccgctatcggctgaatttgattgcgagtgagatatttatgccagccagccagacgcagacgcgccgagacag
aacttaatgggccagctaacagcgcgatttgctggtggcccaatgcgaccagatgctccacgcccagtcgcgtaccgtcctcatgg
gagaaaataatactgttgatgggtgtctggtcagagacatcaagaaataacgccggaacattagtgcaggcagcttccacagcaa
tagcatcctggtcatccagcggatagttaataatcagcccactgacacgttgcgcgagaagattgtgcaccgccgctttacaggcttc
gacgccgcttcgttctaccatcgacacgaccacgctggcacccagttgatcggcgcgagatttaatcgccgcgacaatttgcgacgg
cgcgtgcagggccagactggaggtggcaacgccaatcagcaacgactgtttgcccgccagttgttgtgccacgcggttaggaatgt
aattcagctccgccatcgccgcttccacttttccgcgttttcgcagaaacgtggctggcctggttcaccacgcgggaaacggtctg
ataagagacaccggcatactctgcgacatcgtataacgttactggtttcacattcaccaccctgaattgactctcttccgggcgctatc
atgccataccgcgaaaggttttgcgccattcgatgctagccatgtgagcaaaaggccagcaaaaggccaggaaccgtaaaaagg
ccgcgttgctggcgtttttccataggctccgcccccctgacgagcatcacaaaaatcgacgctcaagtcagaggtggcgaaacccg
acaggactataaagataccaggcgtttcccccctggaagctccctcgtgcgctctcctgttccgaccctgccgcttaccggatacctgtc
cgcctttctcccttcgggaagcgtggcgctttctcatagctcacgctgtaggtatctcagttcggtgtaggtcgttcgctccaagctgg
gctgtgtgcacgaaccccccgttcagcccgaccgctgcgccttatccggtaactatcgtcttgagtccaacccggtaagacacgactt
atcgccactggcagcagccactggtaacaggattagcagagcgaggtatgtaggcggtgctacagagttcttgaagtggtggcct
aactacggctacactagaagaacagtatttggtatctgcgctctgctgtagccagttaccttcggaaaaagagttggtagctcttgat
ccggcaaacaaaccaccgctggtagcggtggttttttgtttgcaagcagcagattacgcgcagaaaaaaggatctcaagaagat
cctttgatcttttctacggggtctgacgctcagtggaacgaaaactcacgttaagggattttggtcagatctagcaccaggcgtttaa
gggcaccaataactgccttaaaaaaattacgccccgccctgccactcatcgcagtactgttgtaattcattaagcattctgccgacat
ggaagccatcacaaacggcatgatgaacctgaatcgccagcggcatcagcaccttgtcgccttgcgtataatatttgcccatagtga
aaacgggggcgaagaagttgtccatattggctacgtttaaatcaaaactggtgaaactcacccagggattggctgagacgaaaaa
catattctcaataaacccttagggaaataggccaggttttcaccgtaacacgccacatcttgcgaatatatgtgtagaaactgccgg
aaatcgtcgtggtattcactccagagcgatgaaaacgtttcagtttgctcatggaaaacggtgtaacaagggtgaacactatcccat
atcaccagctcaccgtctttcattgccatacggaactccgggtgagcattcatcaggcgggcaagaatgtgaataaaggccggata
aaacttgtgcttatttttctttacggtctttaaaaaggccgtaatatccagctgaacggtctggttataggtacattgagcaactgactg
aaatgcctcaaaatgttctttacgatgccattgggatatatcaacggtggtatatccagtgatttttttctccatttagcttccttagctc
ctgaaaatctcgataactcaaaaaatacgcccggtagtgatcttatttcattatggtgaaagttggaacctcacccgacgtctaatgt
gagttagctcactcattaggcaccccaggctttacactttatgcttccggctcgtatgttgtgtggaattgtgagcggataacaatttc
acacaggaaacagctatgaccatgattacgaatttctagataacgagggcaaaaaatgaaaaagacagctatcgcgattgcagtg
gcactggctggtttcgctaccgtagcgcaggccgatatcgtgctgacccagccgccttcagtgagtggcgcaccaggtcagcgtgt
gaccatctcgtgtagcggcagcagcagcaacattggcagcaactatgtgagctggtac

FIG. 7D

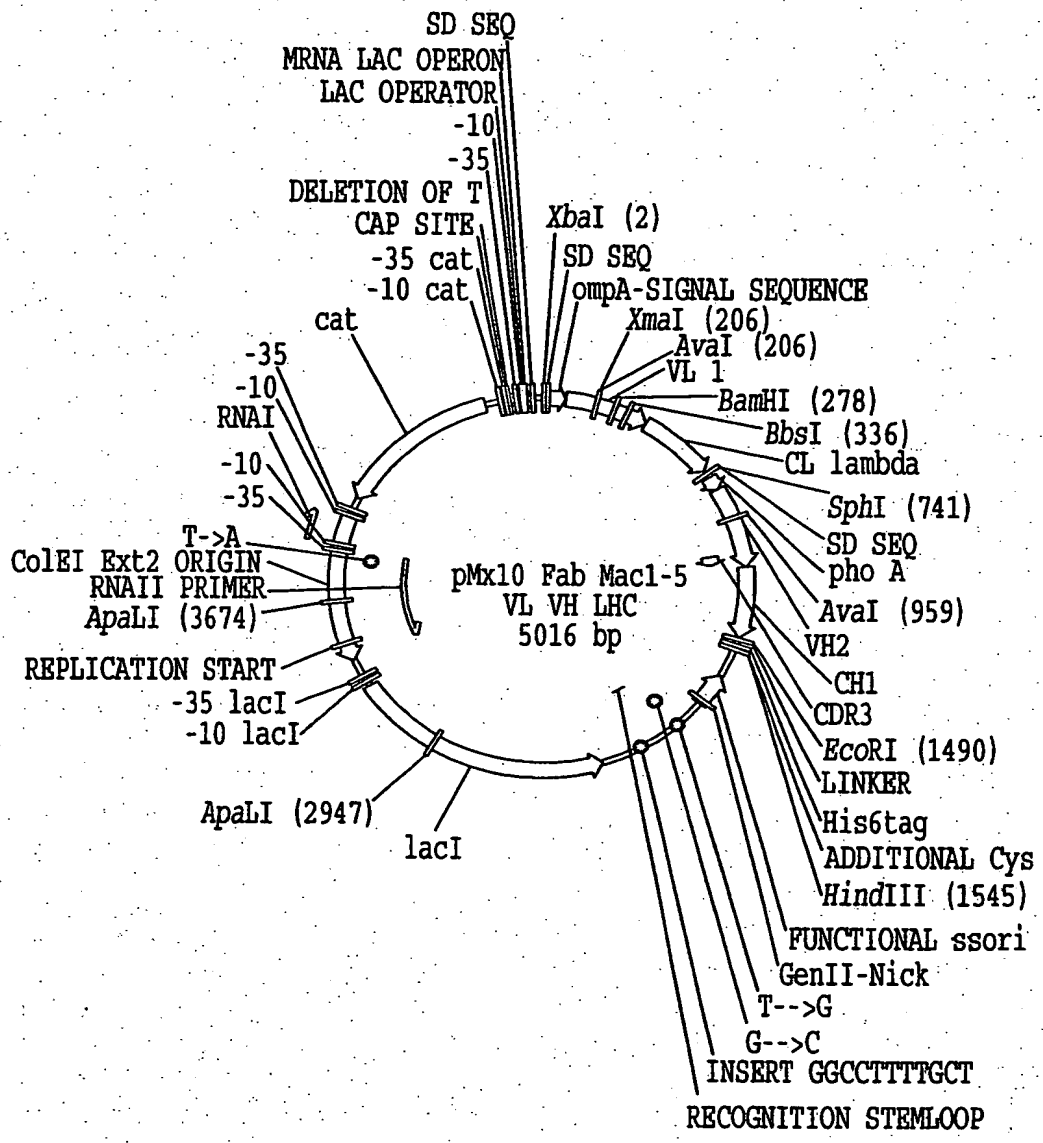

SD SEQ
MRNA LAC OPERON
LAC OPERATOR
-10
-35
DELETION OF T
CAP SITE
-35 cat
-10 cat
cat
-35
-10
RNAI
-10
-35
T->A
ColEI Ext2 ORIGIN
RNAII PRIMER
ApaLI (3674)
REPLICATION START
-35 lacI
-10 lacI
ApaLI (2947)
lacI
XbaI (2)
SD SEQ
ompA-SIGNAL SEQUENCE
XmaI (206)
AvaI (206)
VL 1
BamHI (278)
BbsI (336)
CL lambda
SphI (741)
SD SEQ
pho A
AvaI (959)
VH2
CH1
CDR3
EcoRI (1490)
LINKER
His6tag
ADDITIONAL Cys
HindIII (1545)
FUNCTIONAL ssori
GenII-Nick
T-->G
G-->C
INSERT GGCCTTTTGCT
RECOGNITION STEMLOOP
pMx10 Fab Mac1-5
VL VH LHC
5016 bp

FIG. 7E

gcgacatcgtataacgttactggtttcacattcaccaccctgaattgactctcttccgggcgctatcatgccataccgcgaaaggtttt
gcgccattcgatgctagccatgtgagcaaaaggccagcaaaaggccaggaaccgtaaaaaggccgcgttgctggcgtttttccat
aggctccgccccctgacgagcatcacaaaaatcgacgctcaagtcagaggtggcgaaacccgacaggactataaagataccag
gcgtttcccccctggaagctccctcgtgcgctctcctgttccgaccctgccgcttaccggatacctgtccgcctttctcccttcgggaagc
gtggcgctttctcatagctcacgctgtaggtatctcagttcggtgtaggtcgttcgctccaagctgggctgtgtgcacgaaccccccgt
tcagcccgaccgctgcgccttatccggtaactatcgtcttgagtccaacccggtaagacacgacttatcgccactggcagcagccact
ggtaacaggattagcagagcgaggtatgtaggcggtgctacagagttcttgaagtggtggcctaactacggctacactagaagaa
cagtatttggtatctgcgctctgctgtagccagttaccttcggaaaaagagttggtagctcttgatccggcaaacaaaccaccgctgg
tagcggtggttttttgtttgcaagcagcagattacgcgcagaaaaaaggatctcaagaagatcctttgatcttttctacggggtct
gacgctcagtggaacgaaaactcacgttaagggattttggtcagatctagcaccaggcgtttaagggcaccaataactgccttaaa
aaaattacgccccgccctgccactcatcgcagtactgttgtaattcattaagcattctgccgacatggaagccatcacaaacggcatg
atgaacctgaatcgccagcggcatcagcaccttgtcgccttgcgtataatatttgcccatagtgaaaacgggggcgaagaagttgtc
catattggctacgtttaaatcaaaactggtgaaactcacccagggattggctgagacgaaaaacatattctcaataaaccctttagg
gaaataggccaggttttcaccgtaacacgccacatcttgcgaatatatgtgtagaaactgccggaaatcgtcgtggtattcactcca
gagcgatgaaaacgtttcagtttgctcatggaaaacggtgtaacaagggtgaacactatcccatatcaccagctcaccgtctttcatt
gccatacggaactccgggtgagcattcatcaggcgggcaagaatgtgaataaaggccggataaaacttgtgcttatttttctttacg
gtctttaaaaaggccgtaatatccagctgaacggtctggttataggtacattgagcaactgactgaaatgcctcaaaatgttctttac
gatgccattgggatatatcaacggtggtatatccagtgatttttttctccattttagcttccttagctcctgaaaatctcgataactcaaa
aaatacgcccggtagtgatcttatttcattatggtgaaagttggaacctcacccgacgtctaatgtgagttagctcactcattaggcac
cccaggctttacactttatgcttccggctcgtatgttgtgtggaattgtgagcggataacaatttcacacaggaaacagctatgacca
tgattacgaatttctagataacgagggcaaaaaatgaaaaagacagctatcgcgattgcagtggcactggctggtttcgctaccgt
agcgcaggccgatatcgtgctgacccagccgccttcagtgagtggcgcaccaggtcagcgtgtgaccatctcgtgtagcggcagca
gcagcaacattggcagcaactatgtgagctggtaccagcagttgcccgggacggcgccgaaactgctgatttatgataacaacca
gcgtccctcaggcgtgccggatcgttttagcggatccaaaagcggcaccagcgcgagccttgcgattacgggcctgcaaagcgaa
gacgaagcggattattattgccagagctatgaccagaatgctcttgttgaggtgtttggcggcggcacgaagttaaccgttcttggc
cagccgaaagccgcaccgagtgtgacgctgtttccgccgagcagcgaagaattgcaggcgaacaaagcgaccctggtgtgcctg
attagcgacttttatccgggagccgtgacagtggcctggaaggcagatagcagccccgtcaaggcgggagtggagaccaccaca
ccctccaaacaaagcaacaacaagtacgcggccagcagctatctgagcctgacgcctgagcagtggaagtcccacagaagctaca
gctgccaggtcacgcatgaggggagcaccgtggaaaaaaccgttgcgccgactgaggcctgataagcatgcgtaggagaaaata
aaatgaaacaaagcactattgcactggcactcttaccgttgctcttcacccctgttaccaaagcccaggtgcaattgaaagaaagcg
gcccggccctggtgaaaccgacccaaaccctgaccctgacctgtacctttccggatttagcctgtccacgtctggcgttggcgtggg
ctggattcgccagccgcctgggaaagccctcgagtggctggctctgattgattgggatgatgataagtattatagcaccagcctgaa
aacgcgtctgaccattagcaaagatacttcgaaaaatcaggtggtgctgactatgaccaacatggacccggtggatacggccacct
attattgcgcgcgttttgatccttttttttgattcttttttttgattattggggccaaggcaccctggtgacggttagctcagcgtcgaccaa
aggtccaagcgtgtttccgctggctccgagcagcaaaagcaccagcggcggcacggctgccctgggctgcctggttaaagattatt
tcccggaaccagtcaccgtgagctggaacagcggggcgctgaccagcggcgtgcataccttccggcggtgctgcaaagcagcgg
cctgtatagcctgagcagcgttgtgaccgtgccgagcagcagcttaggcactcagacctatatttgcaacgtgaaccataaaccga
gcaacaccaaagtggataaaaaagtggaaccgaaaagcgaattcccaggggggagcggaggcgcgccgcaccatcatcaccat
cactgctgataagcttgacctgtgaagtgaaaaatggcgcagattgtgcgacatttttttgtctgccgtttaattaaaggggggggg
gggccggcctgcgggggggtgtacatgaaattgtaaacgttaatattttgttaaaattcgcgttaaatttttgttaaatcagctcattt
tttaaccaataggccgaaatcggcaaaatcccttataaatcaaaagaatagaccgagatagggttgagtgttgttccagtttggaac
aagagtccactattaaagaacgtggactccaacgtcaaagggcgaaaaaccgtctatcagggcgatggcccactacgagaaccat
caccctaatcaagtttttggggtcgaggtgccgtaaagcactaaatcggaaccctaaagggagcccccgatttagagcttgacgg
ggaaagccggcgaacgtggcgagaaaggaagggaagaaagcgaaaggagcgggcgctagggcgctggcaagtgtagcggtc
acgctgcgcgtaaccaccacacccgccgcgcttaatgcgccgctacagggcgcgtgctagactagtgtttaaaccggaccggggg
ggggcttaagtgggctgcaaaacaaaacggcctcctgtcaggaagccgcttttatcgggtagcctcactgcccgctttccagtcggg
aaacctgtcgtgccagctgcatcagtgaatcggccaacgcgcggggagaggcggtttgcgtattgggagccagggtggttttttcttt
tcaccagtgagacgggcaacagctgattgcccttcaccgcctggccctgagagagttgcagcaagcggtccacgctggtttgcccc
agcaggcgaaaatcctgtttgatggtggtcagcggcgggatataacatgagctgtcctcggtatcgtcgtatcccactaccgagatg
tccgcaccaacgcgcagcccggactcggtaatggcacgcattgcgcccagcgccatctgatcgttggcaaccagcatcgcagtggg
aacgatgccctcattcagcatttgcatggtttgttgaaaaccggacatggcactccagtcgccttcccgttccgctatcggctgaattt
gattgcgagtgagatatttatgccagccagccagacgcagacgcgccgagacagaacttaatgggccagctaacagcgcgatttg
ctggtggcccaatgcgaccagatgctccacgcccagtcgcgtaccgtcctcatgggagaaaataatactgttgatgggtgtctggtc
agagacatcaagaaataacgccggaacattagtgcaggcagcttccacagcaatagcatcctggtcatccagcggatagttaata
atcagcccactgacacgttgcgcgagaagattgtgcaccgccgctttacaggcttcgacgccgcttcgttctaccatcgacacgacc
acgctggcacccagttgatcggcgcgagatttaatcgccgcgacaatttgcgacggcgcgtgcagggccagactggaggtggcaa
cgccaatcagcaacgactgtttgcccgccagttgttgtgccacgcggttaggaatgtaattcagctccgccatcgccgcttccacttt
tcccgcgttttcgcagaaacgtggctggcctggttcaccacgcgggaaacggtctgataagagacaccggcatactct

FIG. 7F

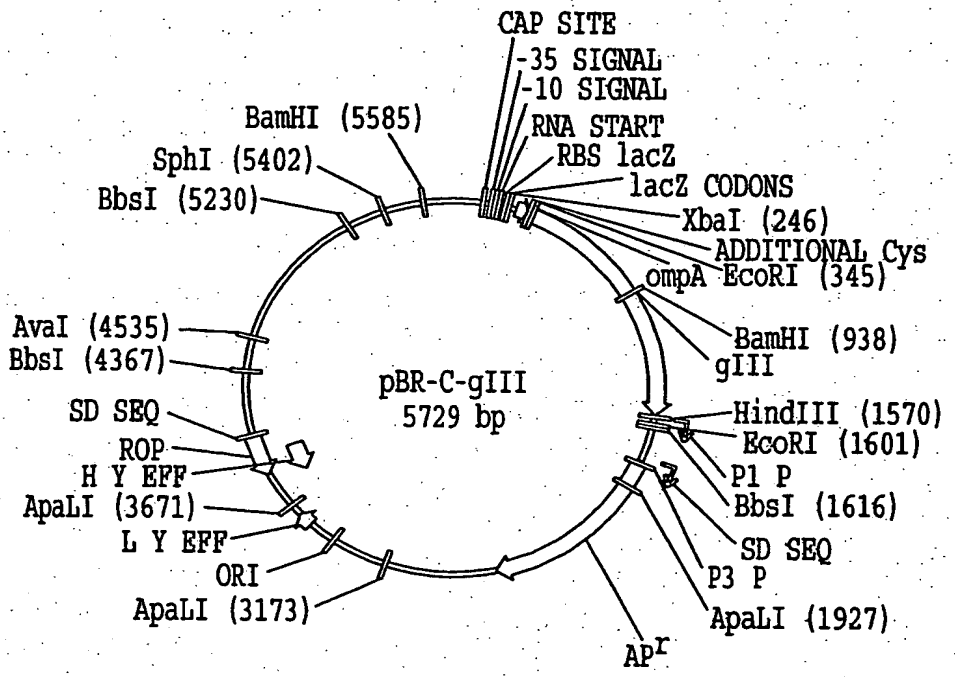

CAP SITE
-35 SIGNAL
-10 SIGNAL
RNA START
RBS lacZ
lacZ CODONS
XbaI (246)
ADDITIONAL Cys
ompA EcoRI (345)
BamHI (938)
gIII
HindIII (1570)
EcoRI (1601)
P1 P
BbsI (1616)
SD SEQ
P3 P
ApaLI (1927)
Ap^r
ApaLI (3173)
ORI
L Y EFF
ApaLI (3671)
H Y EFF
ROP
SD SEQ
BbsI (4367)
AvaI (4535)
BbsI (5230)
SphI (5402)
BamHI (5585)
pBR-C-gIII
5729 bp

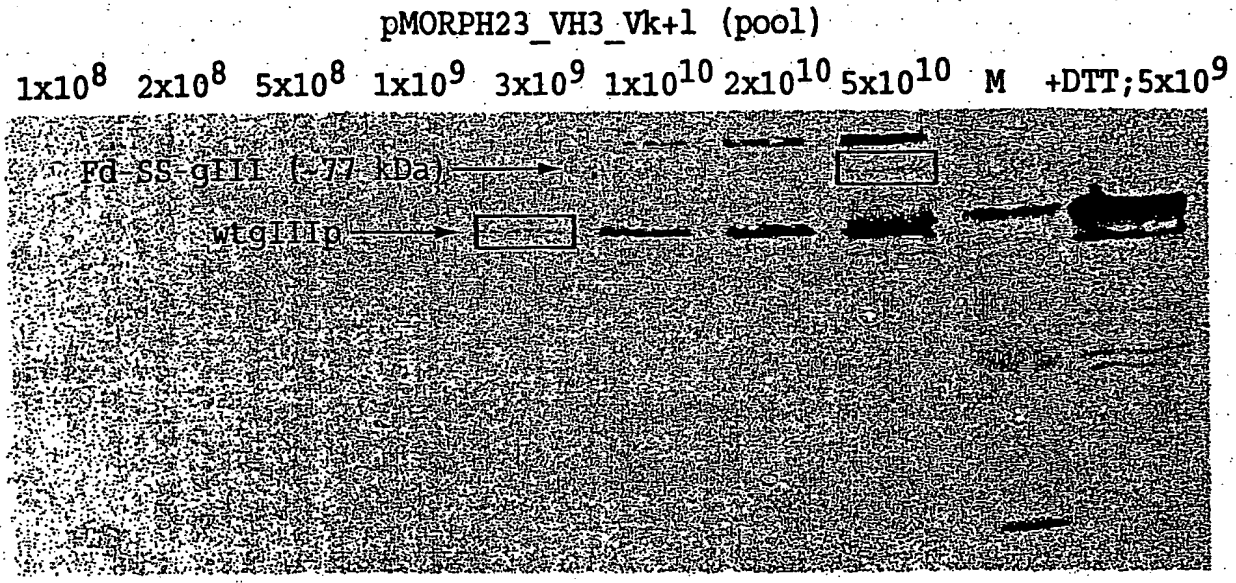
FIG. 7G

caagctgtgaccgtctccgggagctgcatgtgtcagaggttttcaccgtcatcaccgaaacgcgcgaggcagctgcggtaaagctc
atcagcgtggtcgtgaagcgattcacagatgtctgcctgttcatccgcgtccagctcgttgagtttctccagaagcgttaatgtctggc
ttctgataaagcgggccatgttaagggcggttttttcctgtttggtcactgatgcctccgtgtaagggggatttctgttcatgggggta
atgataccgatgaaacgagagaggatgctcacgatacgggttactgatgatgaacatgcccggttactggaacgttgtgagggta
aacaactggcggtatggatgcggcgggaccagagaaaaatcactcagggtcaatgccagcgcttcgttaatacagatgtaggtgt
tccacagggtagccagcagcatcctgcgatgcagatccggaacataatggtgcagggcgctgacttccgcgtttccagactttacg
aaacacggaaaccgaagaccattcatgttgttgctcaggtcgcagacgttttgcagcagcagtcgcttcacgttcgctcgcgtatcg
gtgattcattctgctaaccagtaaggcaacccccgccagcctagccgggtcctcaacgacaggagcacgatcatgcgcacccgtggc
caggacccaacgctgcccgagatgcgccgcgtgcggctgctggagatggcggacgcgatggatatgttctgccaagggttggttt
gcgcattcacagttctccgcaagaattgattggctccaattcttggagtggtgaatccgttagcgaggtgccgccggcttccattcag
gtcgaggtggcccggctccatgcaccgcgacgcaacgcggggaggcagacaaggtatagggcggcgcctacaatccatgccaac
ccgttccatgtgctcgccgaggcggcataaatcgccgtgacgatcagcggtccagtgatcgaagttaggctggtaagagccgcga
gcgatccttgaagctgtccctgatggtcgtcatctacctgcctggacagcatggcctgcaacgcgggcatcccgatgccgccggaa
gcgagaagaatcataatggggaaggccatccagcctcgcgtcgcgaacgccagcaagacgtagcccagcgcgtcggccgccatg
ccggcgataatggcctgcttctcgccgaaacgtttggtggcgggaccagtgacgaaggcttgagcgagggcgtgcaagattccga
ataccgcaagcgacaggccgatcatcgtcgcgctccagcgaaagcggtcctcgccgaaaatgacccagagcgctgccggcacctg
tcctacgagttgcatgataaagaagacagtcataagtgcggcgacgatagtcatgccccgcgcccaccggaaggagctgactggg
ttgaaggctctcaagggcatcggtcgacgctctcccttatgcgactcctgcattaggaagcagcccagtagtaggttgaggccgttg
agcaccgccgccgcaaggaatggtgcatgcaaggagatggcgcccaacagtcccccggccacggggcctgccaccatacccacg
ccgaaacaagcgctcatgagcccgaagtggcgagcccgatcttccccatcggtgatgtcggcgatataggcgccagcaaccgcac
ctgtggcgccggtgatgccggccacgatgcgtccggcgtagaggatccacaggacgggtgtggtcgccatgatcgcgtagtcgat
agtggctccaagtagcgaagcgagcaggactgggcggcggccaaagcggtcggacagtgctccgagaacgggtgcgcatagaa
attgcatcaacgcatatagcgctagcctgaggccagtttgctcaggctctccccgtggaggtaataattgctcgaccgataaaagcg
gcttcctgacaggaggccgttttgttttgcagcccacctcaacgcaattaatgtgagttagctcactcattaggcaccccaggctttac
actttatgcttccggctcgtatgttgtgtggaattgtgagcggataacaatttcacacaggaaacagctatgaccatgattacgaattt
ctagataacgagggcaaaaaatgaaaaagacagctatcgcgattgcagtggcactggctggtttcgctaccgtagcgcaggccga
ctactgcgatatcgaattcgcagaaacagttgaaagttgtttagcaaaaccccatacagaaaattcatttactaacgtctggaaaga
cgacaaaactttagatcgttacgctaactatgagggctgtctgtggaatgctacaggcgttgtagtttgtactggtgacgaaactcag
tgttacggtacatgggttcctattgggcttgctatccctgaaaatgagggtggtggctctgagggtggcggttctgagggtggcggc
tctgagggtggcggtactaaacctcctgagtacggtgatacacctattccgggctatacttatatcaaccctctcgacggcacttatcc
gcctggtactgagcaaaaccccgctaatcctaatccttctcttgaggagtctcagcctcttaatactttcatgtttcagaataataggtt
ccgaaataggcaggggcattaactgtttatacgggcactgttactcaaggcactgaccccgttaaaacttattaccagtacactcct
gtatcatcaaaagccatgtatgacgcttactggaacggtaaattcagagactgcgctttccattctggctttaatgaggatccattcgt
ttgtgaatatcaaggccaatcgtctgacctgcctcaacctcctgtcaatgctggcggcggctctggtggtggttctggtggcggctct
gagggtggcggctctgagggtggcggttctgagggtggcggctctgagggtggcggttccggtggcggctccggttccggtgatt
ttgattatgaaaaaatggcaaacgctaataaggggggctatgaccgaaaatgccgatgaaaacgcgctacagtctgacgctaaagg
caaacttgattctgtcgctactgattacggtgctgctatcgatggtttcattggtgacgtttccggccttgctaatggtaatggtgctac
tggtgattttgctggctctaattcccaaatggctcaagtcggtgacggtgataattcacctttaatgaataatttccgtcaatatttacct
tctttgcctcagtcggttgaatgtcgcccttatgtctttggcgctggtaaaccatatgaattttctattgattgtgacaaaataaacttat
tccgtggtgtctttgcgtttctttatatgttgccacctttatgtatgtatttcgacgtttgctaacatactgcgtaataaggagtcttaa
gcttatcgatgataagctgtcaaacatgagaattcttgaagacgaaagggcctcgtgatacgcctatttttataggttaatgtcatga
taataatggtttcttagacgtcaggtggcacttttcggggaaatgtgcgcggaacccctatttgtttatttttctaaatacattcaaata
tgtatccgctcatgagacaataaccctgataaatgcttcaataatattgaaaaaggaagagtatgagtattcaacatttccgtgtcgc
ccttattccctttttgcggcattttgccttcctgtttttgctcacccagaaacgctggtgaaagtaaaagatgctgaagatcagttggg
tgcacgagtgggttacatcgaactggatctcaacagcggtaagatccttgagagtttcgccccgaagaacgttttccaatgatgag
cacttttaaagttctgctatgtggcgcggtattatcccgtgttgacgccgggcaagagcaactcggtcgccgcatacactattctcag
aatgacttggttgagtactcaccagtcacagaaaagcatcttacggatggcatgacagtaagagaattatgcagtgctgccataac
catgagtgataacactgcggccaacttacttctgacaacgatcggaggaccgaaggagctaaccgcttttttgcacaacatggggg
atcatgtaactcgccttgatcgttgggaaccggagctgaatgaagccataccaaacgacgagcgtgacaccacgatgcctgcagc
aatggcaacaacgttgcgcaaactattaactggcgaactacttactctagcttcccggcaacaattaatagactggatggaggcgg
ataaagttgcaggaccacttctgcgctcggcccttccggctggctggtttattgctgataaatctggagccggtgagcgtgggtctcg
cggtatcattgcagcactggggccagatggtaagccctcccgtatcgtagttatctacacgacggggagtcaggcaactatggatg
aacgaaatagacagatcgctgagataggtgcctcactgattaagcattggtaactgtcagaccaagtttactcatatatactttagat
tgatttaaaacttcatttttaatttaaaaggatctaggtgaagatccttttgataatctcatgaccaaaatcccttaacgtgagttttcg
ttccactgagcgtcagaccccgtagaaaagatcaaaggatcttcttgagatcctttttttctgcgcgtaatctgctgcttgcaaacaaa
aaaaccaccgctaccagcggtggtttgtttgccggatcaagagctaccaactctttttccgaaggtaactggcttcagcagagcgca
gataccaaatactgtccttctagtgtagccgtagttaggccaccacttcaagaactctgtagcaccgcctacatacctcgctctgctaa

FIG. 7H-1

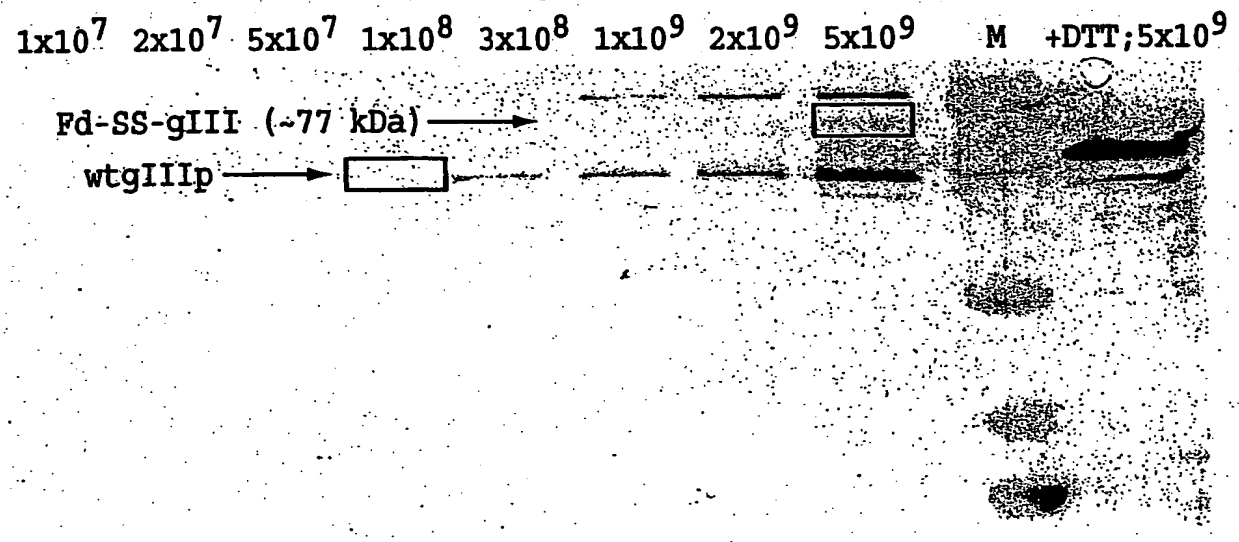
tcctgttaccagtggctgctgccagtggcgataagtcgtgtcttaccgggttggactcaagacgatagttaccggataaggcgcagc
ggtcgggctgaacgggggttcgtgcacacagcccagcttggagcgaacgacctacaccgaactgagatacctacagcgtgagct
atgagaaagcgccacgcttcccgaagggagaaaggcggacaggtatccggtaagcggcagggtcggaacaggagagcgcacg
agggagcttccagggggaaacgcctggtatctttatagtcctgtcgggtttcgccacctctgacttgagcgtcgatttttgtgatgctc
gtcaggggggcggagcctatggaaaaacgccagcaacgcggccttttacggttcctggccttttgctggccttttgctcacatgttc
tttcctgcgttatcccctgattctgtggataaccgtattaccgcctttgagtgagctgataccgctcgccgcagccgaacgaccgagc
gcagcgagtcagtgagcgaggaagcggaagagcgcctgatgcggtattttctccttacgcatctgtgcggtatttcacaccgcatat
ggtgcactctcagtacaatctgctctgatgccgcatagttaagccagtatacactccgctatcgctacgtgactgggtcatggctgcg
ccccgacacccgccaacacccgctgacgcgccctgacgggcttgtctgctcccggcatccgcttacaga

FIG. 7H-2



1 Fd-SS-gIII PER ~3 PHAGE; DISPLAY RATE 0.3

FIG. 8A



1 Fd-SS-gIII PER ~10 PHAGE; DISPLAY RATE 0.1

FIG. 8B

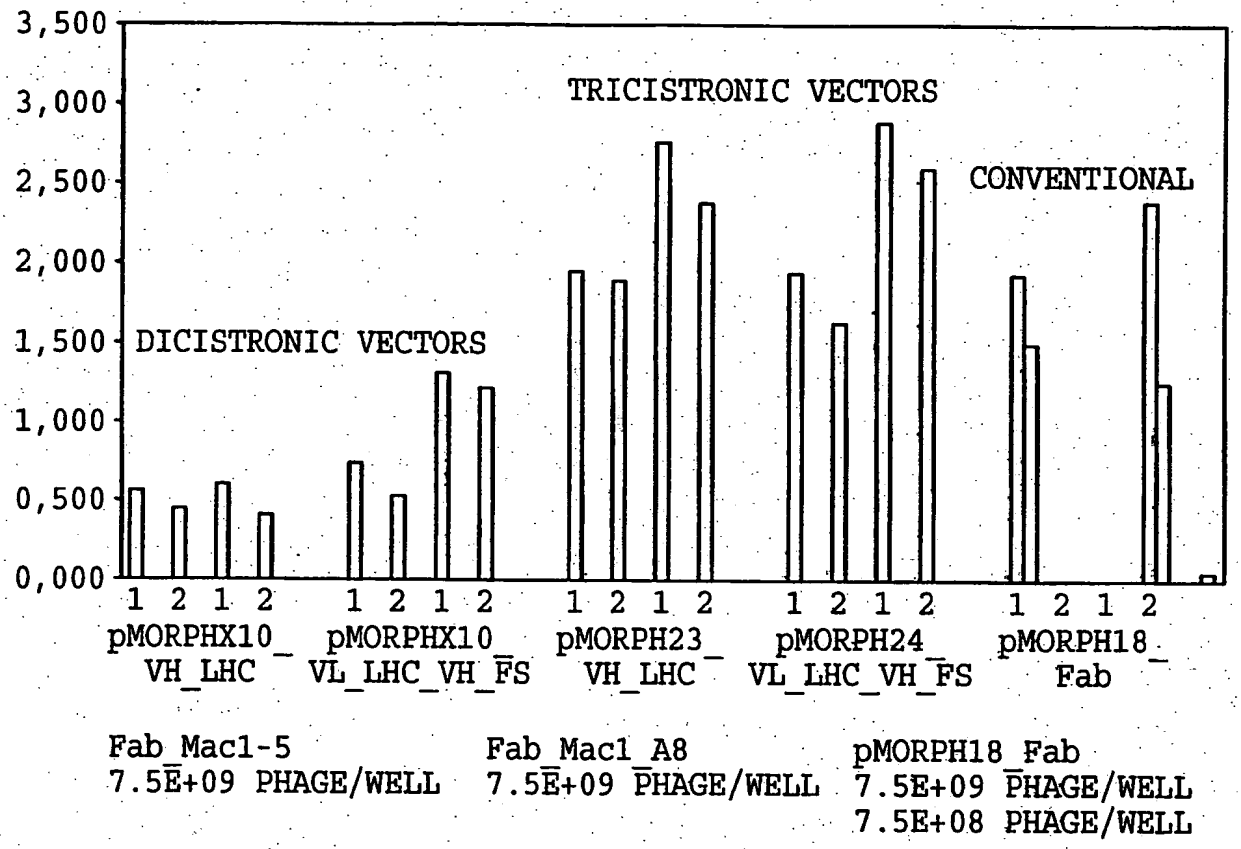

3,500
3,000
2,500
2,000
1,500
1,000
0,500
0,000
TRICISTRONIC VECTORS
CONVENTIONAL
DICISTRONIC VECTORS
1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2
pMORPHX10_ VH_LHC
pMORPHX10_ VL_LHC_VH_FS
pMORPH23_ VH_LHC
pMORPH24_ VL_LHC_VH_FS
pMORPH18_ Fab
Fab_Mac1-5 7.5E+09 PHAGE/WELL
Fab_Mac1_A8 7.5E+09 PHAGE/WELL
pMORPH18_Fab 7.5E+09 PHAGE/WELL
7.5E+08 PHAGE/WELL

FIG. 9